The Builder.

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History of Art in Persia.

IN noticing last month the work by MM. Perrot and Chipiez on the art of Phrygia, Lycia, &c. we referred in passing to their volume on Persian art,* which forms the next and most recent one of the series, and the English translation of which has been issued simultaneously with that of the volume on Phrygia. Considering that the ostensible purpose of the authors has been to trace the stages of development of the forms of Greek architecture, with the intention of leading up to a full treatment of that great subject, it may be questioned whether Persia is not rather a "step aside from the direct forthright;" and indeed the authors seem to think some degree of apology necessary for not proceeding direct to Greece from their previous volume. The excuse is that if Persia had been left, as it were, unconquered in the rear, some return to it would have been necessary when dealing with complete Greek art, to trace the degree of connexion between that and some features of Persian art; that Persia exhibits the latest development of ancient Oriental art, partially influenced by the rising art of Greece, and that therefore its proper place in the series is here. "Henceforward," thay add at the close, "our path is clear, and nothing more interposes between us and Greece, upon which our eyes have ever been fixed, as towards a longed-for goal and land of promise, even when we seemed to wander farthest away from it, and lose sight of its shores amidst the many curves and windings of the way." Certainly the connexion of Persian with Greek art is far less direct and obvious than in the case of Lycian art, and it may even be questioned whether some part of the supposed influence of Persia on Greece, accepted by previous writers on architecture, must not be given up; but the digression is at all events an interesting one, and has given the authors occasion for some studies in restoration which are at least clever and brilliant if not convincing.

The curious problem presented by the remains of Persian architecture of the antique period is, as the authors observe, how to account for an architecture of which columns, doorways, and windows are the sole relics?—The roofs of course we may at once conclude to have been timber, but the matter of the walls is not so easy to deal with. The general view of the platform at Persepolis, with its widely scattered columns and other remains of buildings, is not more fragmentary certainly than the view of the Roman Forum; but taking the view of the remains of the Palace of Darius (fig. 1, see next page) as given by our authors, there is something quite abnormal in this collection of built-up door and window architraves from between which all the connecting walls have disappeared. If the walls were built in large blocks like the door and window architraves, how is it that fragments equal in size to those of the door and window erections have not been found? All that we find between the openings, say the authors, is a kind of foundation of squared stones of never more than two or three courses, "the plinth of a wall that has vanished. Had its composition been akin to that of the substructures, some of its remains, like the splintered shafts and capitals, would be seen around the palaces." The conclusion suggested by the authors is that the interspaces of walling were built up with crude unburned bricks, which would be easily broken down when once the building was deserted, and which in any case centuries of rain and weathering would have disintegrated. In support of this theory they appeal to the fact that M. Dieulafoy found "the mighty ramparts" which surrounded the palaces at Susa entirely built of crude brick. If it seems rather illogical to adduce the presence of existing remains of crude brick at one place to explain the disappearance of all similar remains at another place, the answer may perhaps be that the masses of brick at Susa were too large to be entirely destroyed by time or violence, like the small connecting walls at Persepolis. At all events, there is the problem in the shape of the existing character and position of the masonry remains, and can any better solution be suggested? The reason for this curiously hybrid construction may perhaps be found in the fact that every Persian monarch was desirous of building and living in his own palace, and therefore adopted the method of building which would lead to the quickest result, confining the finished masonry to the salient portions of the architecture, and filling in the remainder expeditiously and cheaply, facing the crude brickwork with enamelled tiles.

The characteristic column and capital of Persian architecture (fig. 2) is one of the most curious and complicated features of the kind, one of the most unsatisfactory jumbles of good and bad design, which the whole history of architecture has to show. The base is a good piece of design, except that in this example the decoration is hardly sufficiently distinct in effect from the fluting of the column above; this, however, is not always the case, some of the examples showing a much more marked and individual decoration of the base. The upper portion of the column shows a conglomeration of features having nothing in common and no structural relation to one another, a matter of great importance in the case of so specially structural a feature as a column. The inverted bell-and-flower capital which is placed directly on the shaft is a very graceful detail in itself, and would even make a suitable enough capital for a light superstructure. The double bull-head bracket which forms the upper member is also a fine piece of design and very well suited as a decorative bearing for a timber superstructure, but it is utterly out of keeping with the bell-and-flower feature below, while the scrolls placed vertically between the two are out of keeping with both, and form a detail completely misplaced, having no structural connexion with what is above or below them, and forming a weak feature exactly where constructive strength is most required. Had the Persian architects placed the bull-head bracket immediately on the top of the shaft, with a moulding interposed to form a seat for it, they would have deserved the credit of having invented an original and artistic feature; as it is, they produced a tasteless jumble of

* History of Art in Persia. From the French of Georges Perrot and Charles Chipiez. London: Chapman & Hall. New York: A. C. Armstrong & Son. 1892.

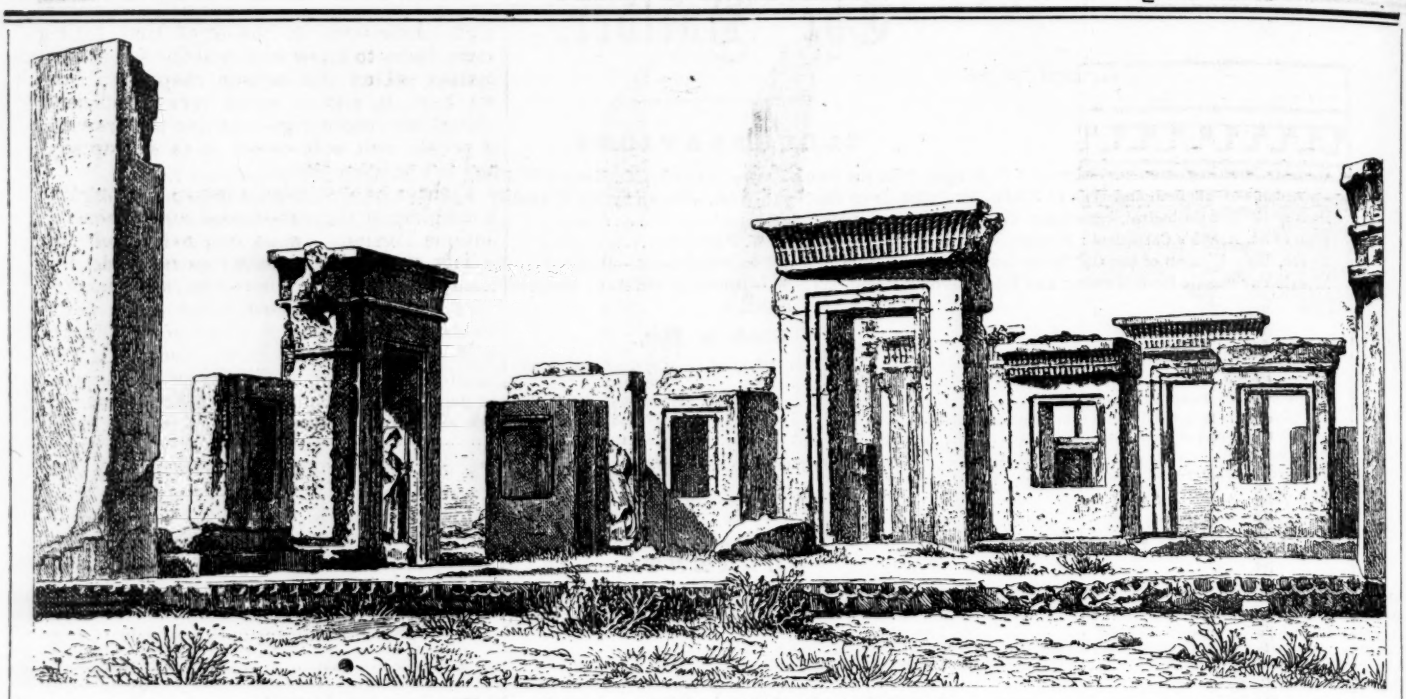

Fig. 1.—*Remains of Palace of Darius at Persepolis.*

details all elegant in themselves, but utterly spoiled by the manner in which they were combined. Some recent writers on architecture have been betrayed into bestowing most unmerited praise on this Persian column, apparently merely because it is a piquant variation from the Classic column, which they are tired of praising; MM. Perrot and Chipiez,

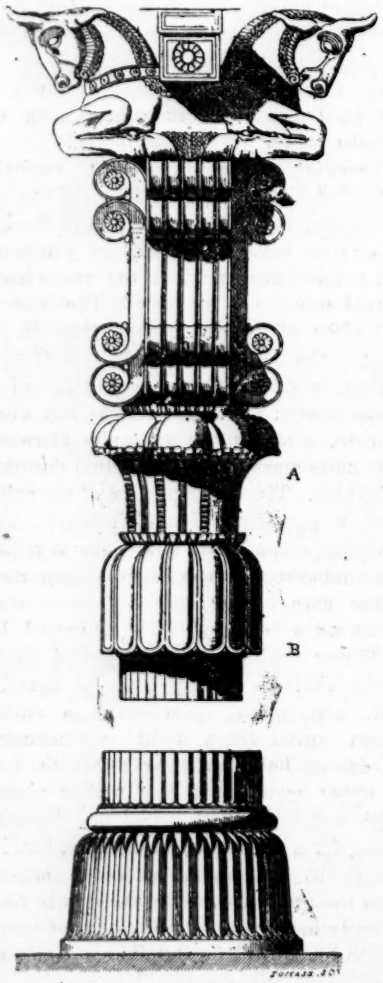

Fig. 2.—*Base and Capital, Persepolis.*

we are glad to observe, show more critical discernment, and are fully alive to the æsthetic defects of this feature, while they take great trouble in illustrating it. As to the origin of this curious combination it seems hardly likely that we shall ever get at any decisive facts. As to the bracket form of the capital, spreading out laterally on each side of the column, the authors join with M. Dieulafoy in thinking that the modern peasant's house as represented in fig. 3 is the ancient form of rural Persian habitation preserved nearly unaltered to the present day, and that here we have the origin of this bracket form of capital in its rudest and unworked state.* We fear we must retain our attitude of scepticism as to these rural types which we now meet with in almost every French book on the history of architecture, and which seem to come in so opportunely and to be so exactly suited to the historian's requirements. This illustration is taken from MM. Perrot and Chipiez's book, who take it from M. Dieulafoy's book; and through how many hands has it passed between the actual existing hut and the engraving on M. Dieulafoy's pages? Did M. Dieulafoy see it, just as represented here, with his own eyes? We very much question it, and we must say that we have been impressed over and over again, of late years, by the remarkable faculty of French archæologists for seeing things which are favourable to their own theories. Viollet-le-Duc had a great deal too much of this kind of archæological second-sight; we find it in Lesueur's brilliant work on Classic architecture, we noticed it the other day in MM. Garnier and Ammann's book on the "History of the Habitation"; we seem to see it here again. Peasants' huts showing the *origines* of the architecture of a country have the most remarkable knack of turning up in French historical books on architecture. Such indications are of the highest interest where they do exist, but we should rather like to see direct reproductions from photographs of the original structures, instead of neatly made-out engravings in which we have no means of tracing the relation to the original structure, or even to the original sketch of it.

In regard to one other point in the Persian capital, the vertical volute, the authors make no remark as to the possible connexion between that and the volute of the Ionic capital, and we may hazard the opinion that if there is any such connexion, it is in the contrary direction to that suggested by Fergusson, who assumed that in this Persian capital we had the origin of the Ionic volute. But the volute in its proper horizontal position had occurred long before this in Lycian monuments, and in reality the volute set up on end is such a radically different idea from the volute set horizontally that there is really no need to imagine a connexion between one and the other. But if there is any connexion, the probability is that it was the Persians who clumsily misused the Lycian and early Greek form.

Fig. 3.—*Modern Peasant's House, Mazanderan.*

There is a good deal of imagination also, though doubtless of a very ingenious nature, in the elaborate restorations of the wooden roofs of the Persian palaces given by M. Chipiez. "We are able," say the authors, "to restore them from the notches they have left at the summit of the antæ and pilasters both at Pasargadæ and Persepolis." The exact extent of the authority given for the restoration is shown in figs. 4, 5, 6, and one of the smaller "restorations" (by M. Chipiez) is shown in fig. 7. It will be admitted that this is a good deal of timber detail to evolve out of the notches in two square stone columns, and a rude representation of the front elevation in a rock-cut copy. That the notches in the stone columns do indicate where timber has been framed into them there can be little

* The argument of the authors that "the beam is more apt to give way under the burden of the roof than would a stone of the same dimensions," and that the bracket shape is therefore used to reduce the bearing, is a very odd one, if it means (as the words seem to imply) that a timber beam will not take so long a bearing as a stone one.

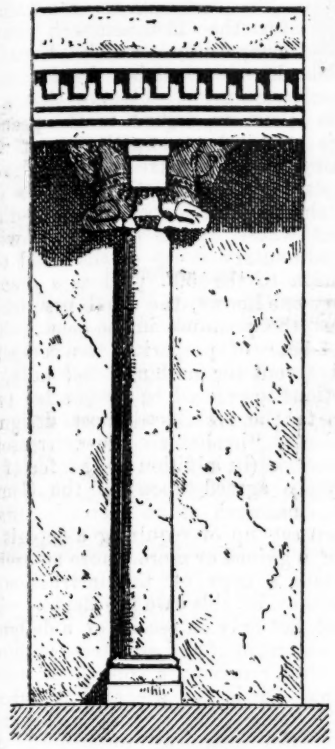

Fig. 4.—Part Elevation of Rock-cut Tomb, Naksh-i-Rustem.

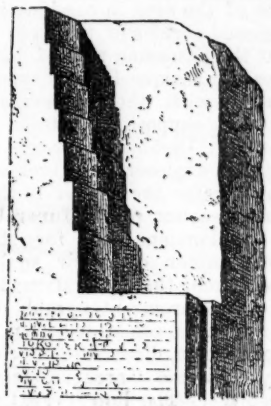

Fig. 5.—Detail of Upper Part of Stone Pillar, Persepolis.

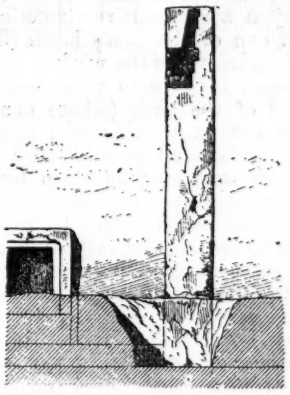

Fig. 6.—Pillar, Persepolis.

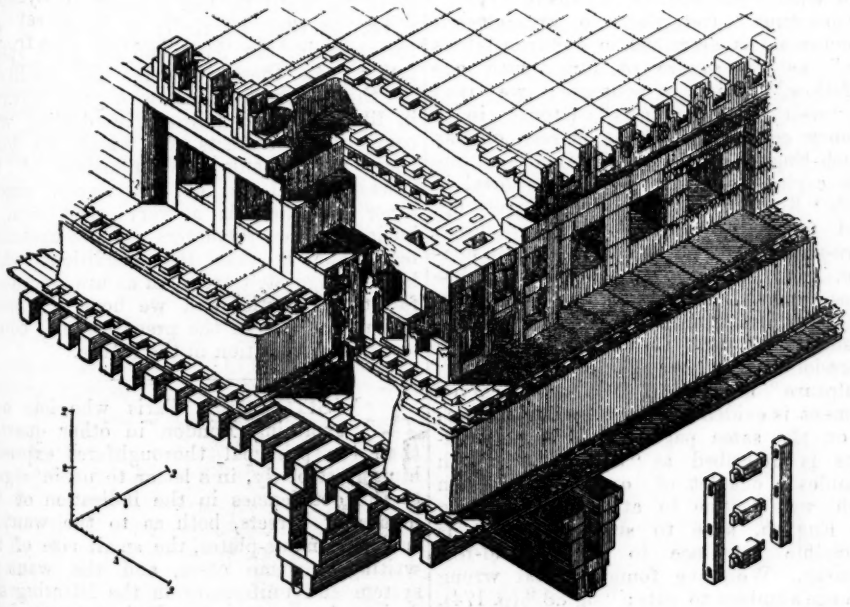

Fig. 7.—Restoration of Timber Roof, Persepolis.

doubt, and the restoration of it is a remarkable exercise of architectural ingenuity; but after all it is only ingenuity, and the drawback to this kind of invention is that when laid down in an elaborate drawing in this manner, it is liable to be taken by many readers as proven fact, and even to stand established as a precedent for future archæologists to base further theories on. It was a weakness (some people may call it the reverse) of the late Mr. Fergusson, that whenever he had framed what appeared to his mind a satisfactory theory about any detail of plan or construction in ancient architecture, he thenceforth regarded and referred to it as if it were ascertained fact, and this dogged persistency in his own belief had really a great deal to do with the wide acceptance he obtained for many of his views. His theory as to the lighting of the Greek temples, for instance, seemed so consistent and logical, and was so positively asserted by himself, and moreover would no doubt have been such an effective and effectual mode of internal lighting, that people gradually came to forget that there was not a shadow of proof or indication of it in any ancient remains, coins, or descriptions, and that all that could be claimed for it was that it was quite possible, and not entirely at variance with the pediment termination of a Greek temple. Now that it has been suggested that after all, in a bright climate, the open door might give all the daylight that was wanted in a temple interior, it is seen that Fergusson's elaborate scheme was quite uncalled for, and probably little more will be heard of it among those who think for themselves. Yet it is only a few months since that we saw it stated in the syllabus of some educational lectures on architecture as if it were historical fact. So it may be with M. Chipiez's restoration of the roofs and ornaments of the Persian palaces, which nevertheless are conjectural in all but the profile which abutted on the stone piers. The volume contains an excellent chromolithograph reduction from M. Chipiez's beautiful water-colour drawing which was exhibited in the Architectural Gallery at the Paris Exhibition of 1889, and which we mentioned at the time in terms of high admiration, at the same time feeling some desire to know what was the solid information behind this artistic rhapsody. Now we have it, and it seems very insufficient, though we cannot regret having the drawing, if people will only regard it as a rhapsody, and not as sober fact.

Perhaps no architecture presents so singular a mingling of suggestions and associations as antique Persian. In its employment of bas-reliefs of winged bulls as entrance decorations, in its lion friezes, its battlemented terminations, in the general feeling pervading the architectural design, it has strong affinities with Assyrian art. In the decoration and treatment of some of the doorways we seem to see Greek detail in a less refined form; in the doorway from a hypostyle hall at Susa, for instance, given (page 129) from Dieulafoy, we see the moulded architrave with the repeated rosette ornament on the space between the mouldings, as in the Erechtheion doorway, and a coarsely designed bead-and-reel ornament within the inner moulding; while again in the crowning member or cornice of the door-architraves we see the distinctly Egyptian form of cornice (fig. 8),

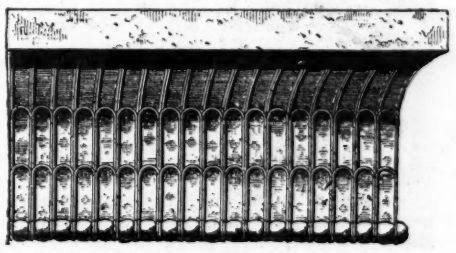

Fig. 8.—Cornice of Doorway, Persepolis.

though with a difference in the surface ornamentation, the ribbing being in three tiers instead of continuous, and the lower member a bead-and-reel instead of a continuous roll. It may be observed that the profile of the cornice, as shown in this illustration, is much less refined in its curve than the best Egyptian examples, being apparently a mere segment of a circle at the top, whereas the Egyptians employed a more refined compound curve, apparently part of an ellipse. The few mouldings given in the book, it may be observed, are sufficient to show the coarse perception and practice of the Persian architects in respect to this important class of detail, a defect which in itself would be sufficient to put their architectural art on a second-rate level. In regard to the quasi-Egyptian form of door-cornice, the authors observe that Texier, in his restorations of Persian architecture, crowned all the buildings with this moulding, as in Egypt, because he had found it on the door architraves; but of course the theory (which seems incontestable) that the roofs and main cornices were of timber would leave no place for such a feature there.

The typical plan of a Persian palace, with columns equally spaced over the floor, may also have some connexion with the Egyptian temple plan, as the authors suggest; though to our thinking the central avenue with larger and loftier columns and a clearstory over them, typical of the Egyptian plan, is so important and so fine a feature that we can hardly imagine any architects of another country copying the Egyptian pillared hall and omitting that feature, and therefore we should be disposed to doubt the connexion between the two; if the Persian pillared hall is copied from the Egyptian, it is miserably spoiled in the copying. In regard to the large hypostyle hall at Persepolis, the authors criticise Fergusson's restored plan,* in which Fergusson shows complete walls surrounding the central mass of columns, and crossing at the angles, like very much developed antæ, so as to flank and "stop" the outer colonnades on the front and sides. We quite agree with them that Fergusson's small chambers placed in the re-entering angles of the crossed walls are

* Fergusson's "History of Architecture," second edition; Vol. I. Fig. 90.

purely imaginary and do not look very probable; but his front line of wall, separating the front colonnade from the square columned hall in the rear, follows the line given by the existing masses of masonry forming the jambs of the great doorways behind the front colonnade, and central with two of its intercolumniations; and if this front wall is admitted, the side walls follow as a matter of course. But then, say the authors, on the plan of the existing remains of this hall (given as Fig. 148 in their book), there will be seen traces of drains, which run right under the line of Fergusson's side walls, "a strange oversight on the part of the architect thus to undermine his own work"; and if this plan is correct, the criticism is a sound one. In this

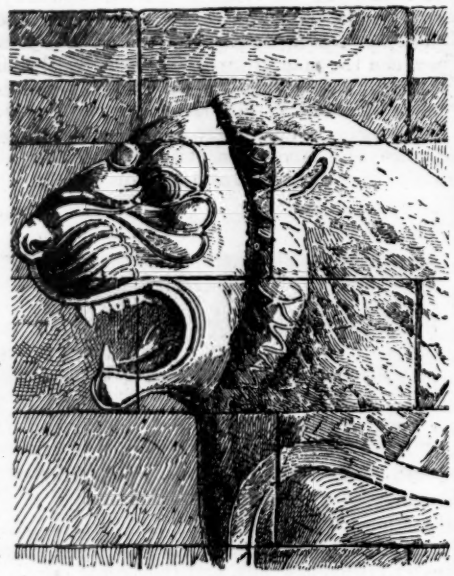

Fig. 9.—Head of Lion from Frieze, Susa.

case the authors opine that the remains supposed to represent doors are only ceremonial niches or state arches standing free, and which did not form part of any wall. But then the plan with the drains is only reproduced from Flandin and Coste, and rests on no personal observation of the present authors, and in regard to the so-called door-jambs, only minute examination on the spot could decide whether these were or were not parts of a continuous wall. We agree that Fergusson's plan looks clumsy and doubtful, and the suggestion of the authors that the hall had no solid surrounding walls but was a great columned enclosure of state is interesting and worth attention; we must refer the reader to the book for the full arguments and illustrations; but all this as well as other speculation in the book appears, as far as we can understand, to be based on second-hand evidence; very good second-hand evidence, but still no more than that. To get through such a series of works as the authors are bringing out it is necessary to trust a great deal to second-hand evidence, but no one can have any right to speak positively on such a point as this one, for example, except on the basis of direct personal inspection; plans taken from other publications may be prejudiced in ways we do not know of; the most careful and conscientious account or delineation in books may convey an impression quite different from what a personal inspection gives. And we are rather in this difficulty with MM. Perrot and Chipiez's books, that we do not seem to have a clear understanding as to how much they are giving from their own observation and how much on the authority of other narrations. That there has been a certain amount of personal observation is evident, it is also evident that there is a great deal of second-hand information, and it is for the most part not very easy to say on whose particular observation any one statement rests.

The authors devote more space than was at all necessary to answering M. Dieulafoy's extravagant idea (founded upon a single occurrence of the arch in combination with a badly-designed cornice of the type shown in fig. 8) that the Sassanian type of domed architecture was an antique Persian type practised concurrently with the columnar type of Persepolis; a supposition which can only prove that M. Dieulafoy, though an ardent and successful explorer, is no archæologist.

We must refer the reader to the book itself for any account of the funeral architecture of the Persians, and for the largely illustrated chapter on their sculpture and decoration, among the illustrations to which is included a fine chromo-lithograph representation of the now celebrated lion frieze in glazed terra-cotta, discovered at Susa by M. Dieulafoy, and the "archer's frieze" from the same place. The lion frieze, though stiff and formal, is very forcibly modelled, and may be considered a masterpiece of conventional treatment of animal forms as ornament. We subjoin a reduced reproduction of the detail of one of the lion's heads (fig. 9), to show the character of the work.

We regret to have to point out that the translator of the book (whose name is not given) is not up to his work; he evidently does not understand many French architectural terms, and supplies them by a mere adoption of the same expression in English, with a result which must be puzzling to readers who are not acquainted with architectural phraseology, and irritating to those who are. Of instances where words are used without meaning or with a wrong meaning, we note "lofts" and "cranks" (p. 48); the "membering of bases" (p. 53) meaning the moulding; "plat-band" over and over again as a translation of "plate-bande," which merely shows that the translator does not know what "plate-bande" means in French; a "quincunx" (referring to arrangement of columns) is described in a "translator's note" as "a square of four, with one to follow," which is nonsense; we read of "well-squared units" (stones in a masonry course), which is merely clumsy French-English; of the "spires" of the Ionic capital; of "dentels;" of a portal in which "five delicate listels are happily opposed to a platband;" of "extra-dosed (*outre-passées*) arches," which is absolute nonsense, "outre-passées" meaning horse-shoe arches, returned past the level of the springing; of a "bay full centred," which is the translator's attempt to render the French expression for a semi-circular arched bay; "sculpture" is used (p. 494) where carved ornament is evidently meant by the authors; and on the same page one of these ornaments is described as "a baguette which resembles a chaplet of oves," a definition which we decline to attempt translating into English, save to suggest that it is a possible reference to a bead-and-reel ornament. We have found several wrong reference numbers to cuts; "fig 88" (p. 174), "fig. 74" (p. 182), "fig. 111" (p. 359) are all wrong. This is carelessness, but the other blunders arise from sheer ignorance of the subject; and if the publishers are going to issue translations of other French works of this class, they should be warned that it is necessary to engage a translator who has a knowledge of architecture as well as a knowledge of French. In other repects the book is admirably produced. It should be observed that the illustrations given with this article are not to be taken as adequately representing the illustrations of the book; they are merely selected as necessary to explain our remarks, and have been reduced in size, and portions of them in some cases omitted, to bring them within our available space.

SEWERAGE, WOODHALL SPA.—The *Nottingham Express* reports that the Horncastle Rural Sanitary Authority, at their meeting on the 23rd ult., approved the scheme for the sewerage of Woodhall Spa, prepared by Mr. Herbert Walker, A.M.Inst.-C.E., of Nottingham. The present sewers will be utilised for storm water, and the Shone system is to be adopted for carrying away the sewage. Application has been made to the Local Government Board for sanction to a loan to cover the cost of these works.

NOTES.

IN the instructions to architects for the Bournemouth Pavilion competition, which have been drawn up under the direction of Mr. Charles Barry, we observe that a good example is set in regard to the pecuniary dealings with the competitors,—of which competing architects have often much reason to complain. In the first place it is stated that if the Council carry out the work, the architect whose design is selected will be employed to carry it out on the usual terms, in addition to the 50*l.* paid as a premium. As every one knows, the usual practice is to "merge" the premium in the commission, as if the labour of preparing the competition drawings went for nothing. Secondly, if no instructions to proceed be given after twelve months to the architect whose design has been selected, "he shall receive such reasonable compensation (in addition to the fee of 50*l.*) as may be agreed upon by the Council." Thirdly, inasmuch as an increasing practice has been set up of requiring a deposit payment of a guinea or more before an architect can obtain a copy of the instructions, we observe that in this case the deposit will be returned not only on receipt of a design, but on the statement of any architect, within two weeks after receiving a copy of the instructions, that he is not prepared to submit a design. Some time ago we called attention to the practical unfairness of requiring a deposit payment for the instructions which was only returnable on receipt of a design; for this reason, that the architect in most cases has no means of knowing whether the competition is such a one in its terms and requirements as he would wish to go in for, until he has perused the instructions, so that he really is made to pay for them in the dark and on pure speculation. In these respects the conditions of this competition show a great advance in liberality and fairness in dealing with competing architects, for which no doubt they may thank the influence of the assessor; and as Mr. C. Barry, among other qualities, is a very good man of business, the promoters of competitions may take it that the conditions which he has suggested are such as are practically fair to all parties, and we hope the lesson will not be lost in the preparation of conditions of competition in the future.

A VISITOR from Paris who has been exploring London in other quarters than the principal thoroughfares expresses himself strongly, in a letter to us, in regard to the deficiencies in the indication of the names of streets, both as to the want of sufficient name-plates, the small size of the writing in some cases, and the want of system and uniformity in the lettering and design of street names. It is not surprising that any one accustomed to the regular and clear street-labelling of Paris should make such a criticism, and of course the inconvenience of this deficiency in our street naming is felt by a stranger endeavouring to make acquaintance with London to a much greater degree than by a Londoner. We have often remarked, however, the haphazard manner in which the labelling of streets is carried out in London, which much needs a thorough reform, and we are glad to give currency to our correspondent's complaint.

SEVERAL well-known artists and public men, headed by the Duke of Westminster, put their names the other day to a short letter in the *Times* expressing their great regret at the proposed demolition of Emanuel Hospital, Westminster; a regret which we fully share. In the *Times* of Tuesday last the Earl of Carlisle (to use an American phrase) "goes them one better" in a letter adding his protest, and describing the proceeding as "a wanton piece of vandalism." To express regret is one thing; to talk of "wanton vandalism" is another, and the expression only shows how little some of

these æsthetic protestants are able to weigh the meaning of words or to look at two sides of a question. It appears that the building is no longer practically fitted for the purposes of the charity, and that by selling it the trustees can obtain funds which will enable them to adminster the charity more effectually and to provide a building suitable to modern requirements. Under such circumstances they would not be doing their duty if they followed any other course, and there is obviously nothing "wanton" in the matter, unless we were to call the Earl of Carlisle's language wanton abuse of words. Two or three of the men who have protested are very wealthy; will they buy the building and site and present it to London? Every one will thank them for that; but they have no right to abuse trustees of a charity for selling property which has become useless for the purposes of the charity. The building, after all, is not pulled down yet; and at the worst it is not the trustees of the charity who are pulling it down; they are only selling it.

IT is singular how those who are interested in seaside resorts are constantly doing their best (from mere money-grubbing motives) to make them less attractive. Lowestoft has many attractions over various marine resorts, not the least being the stretch of common at the northern end, well raised above the sea, and separated by the Yarmouth-road from the cultivated land which runs inland. But the common appears now to have fallen into the hands of a building syndicate, together with other land in the vicinity, and it is the desire of those who now possess the common to cover it with buildings. Such a piece of land, breezy and bracing, is invaluable as an open-air resort. Covered with lodging-houses, it will cease to be an attraction to the seeker after fresh air. It is too far from the beach to be appreciated as a building site by what we may term the cheap seaside frequenter. It should be retained as an open space. If this were done, and good-class houses were built on the west side of the high road, it would make them some of the most "desirable" residences on the east coast, being within easy reach of the sea, not distant from Oulton Broad, and with an open space in front. If there is any public spirit in Lowestoft it should be stirred to prevent this common from being sacrificed to the builder. If this mistake can be prevented it will certainly be to the ultimate profit of the town.

IN the last issue of the German Archæological Jahrbuch (1892, vii. 2), Dr. Winter has a valuable paper on a particular branch of the ornamentation of Greek vases. It has the rare merit of being fully illustrated, so that it can be read and understood without reference to the illustrations of countless other foreign publications. The decorations discussed are those that occur *below the handles* of Attic cups. So little attention has been paid to this branch that not unfrequently the main designs of a vase are published and discussed while the subordinate decoration beneath the handles is wholly omitted even from the picture. After Dr. Winter's paper, this omission will become an impossible anachronism. He clearly shows that this subordinate part of the decoration is subject to a development as marked and as definitely chronological as that of the main design itself. Nay more he shows that within its limits certain mannerisms occur characteristic of certain masters, so that the decoration below the handles become an additional piece of evidence in the attribution of doubtful vases to particular names. Much of Dr. Winter's work in this special branch was carried on at the British Museum.

THE French School of Archæology at Athens is not yet, according to the report of the new director, M. Homolle, fully re-organised. It, therefore, issues this year only a *supplément* to the full number of the Bulletin for 1891. This supplement contains a valuable *résumé* of news as to recent excavations. Most of these we have from other sources noted before, but some items from French sources for the most part, appear here for the first time. M. Holleaux, in a letter to M. Homolle, reports the concluding operations at the Sanctuary of Apollo Ptoïos, near Acraiphiæ, in Bœotia. Besides a mass of archaic inscriptions, containing, among other valuable things, two signatures of sculptors hitherto unknown, the last year's work has been specially rich in bronzes. Among these, unquestionably the most important are a whole series of archaic bronze plates decorated with repoussé work; the designs include decoration that is merely linear, subjects drawn from the animal and vegetable world, frieze of fantastic animals, and, finally, certain mythological scenes. One plaque, which is fairly-well preserved, represents the combat of Zeus with Typhon, and is therefore of interest for comparison with the archaic sculptured pediment found in the Athenian Acropolis; another represents the punishment of Prometheus. At the first glance, M. Holleaux says the analogy is striking between these bronzes and those supposed to be of Argive origin, found at Dodona, Olympia, and at Athens. The most interesting of these are shortly to be published in the *Bulletin*. M. Holleaux greatly regrets that the limited funds at his disposal have not enabled him to excavate or even precisely to determine the site of the theatre, the existence of which is certain from inscriptions. At Lepréon, in Elis, important ancient remains have long been subjected to repeated depredations by the people of the neighbouring village of Strovotzi, who eagerly sought after both stone and lead for the building of their houses. Happily, Dr. Dörpfeld reported on these depredations to the Ephor of Antiquities, and they have been stopped. It is proposed shortly to begin a regular system of excavation. Dr. Dörpfeld thinks that the ruins must belong to one of the temples mentioned by Pausanias, either that to Demeter or to Zeus Leukaios. More it is impossible at present to say, except that the building was a peripteral temple, dimensions 11 by 19 m., with cella and pronaos. On the lower terrace architectural fragments of all sorts are lying in masses,—drums of columns, Doric capitals, triglyphs, and metopes. It is hoped that these excavations may yield rich results.

MR. HENNIKER HEATON'S latest method of drawing attention to unredressed postal grievances is decidedly novel, not to say amusing. The irrepressible member for Canterbury has addressed a letter to the *Times*, in which is incorporated a suggested "Supplementary Post Office Report," which he submits to the Postmaster-General for his approval and signature. It consists of nineteen clauses, which are virtually so many confessions of failure or of indifference, and the Postmaster-General is apparently invited to throw all the blame upon the high permanent officials of the Department, "who," he is made to say, "are my advisers, or rather controllers." A variation of this refrain is introduced into the majority of the nineteen clauses, culminating in the following crushing piece of sarcasm: — "There is a tendency among the postal staff to resist the introduction of changes in administrative methods as far as possible. Their eyes are bandaged with red-tape, and their ears are stopped with sealing-wax. They hold that the Department received so sudden and violent an impetus in 1840 that it will be absolutely necessary to apply the brake for at least another century." The Postmaster-General is invited "to blush to acknowledge that a fee of 2d. is still charged for a receipt for a 6d. telegram, although the Exchequer only receives 1d. on a receipt given by a merchant for 1,000*l*." This is an anomaly which would certainly not be tolerated but for the fact that such receipts are very rarely required. Another of the matters dealt with is one which we remarked upon not long ago, —viz., the inability of the English public to obtain the stamps of the British colonies and dependencies; it being, therefore, impossible to enclose with a letter addressed abroad the proper stamp for a reply, however desirable it may be to do so. The helpless and apologetic official is made to say, "I have found myself powerless to effect this reform, although, like every sensible man, I am convinced that it would be very useful and convenient." It appears that at Melbourne, Sydney, and other large colonial towns, our British stamps are regularly sold, so that it should not be such a difficult matter to obtain Australian and other colonial stamps at home. Formidable as is Mr. Henniker Heaton's list of postal anomalies, several of the old grievances have dropped out, and the indefatigable perseverance of the hon. member, and his characteristic freedom of utterance (always irrespective of the Party to which the chief at St. Martin's-le-Grand for the time being belongs), will doubtless result in the gradual removal of others.

LORD FITZWILLIAM'S seat, Milton, or Abbey Milton, which narrowly escaped from destruction by fire a few days ago, is situated in Castor parish, near Peterborough. Eight hundred years ago the Abbot of Burgh had two hides in Meletone, and it continued to be held of the Abbots of Medehamsted by various people,—amongst them being Richard de la Pole, and the De Veres, Earls of Oxford,—until the attainder of John de Vere, in 2 Edward IV., when it passed to Richard, Duke of Gloucester. The property was held next by the Wittelburys, of whom Robert Wittelbury conveyed it, in 18 Henry VII., to William Fitzwilliam, a descendant of Sir William FitzGodric, cousin to Edward the Confessor. He is the Fitzwilliam, a citizen of London, whom Henry VIII. knighted and made a Privy Councillor upon his spirited justification when taken to task for sheltering his former master and benefactor, Wolsey, after the Cardinal's downfall.* His grandson, Sir William, was governor of Fotheringhay during Mary, Queen of Scots' imprisonment there: and on the demolition of that castle several coats-of-arms were removed to the hall and parlour windows at Milton. The main portion of the house was built in the middle of the sixteenth century. The principal, and Tudor, front consists of several bays, embattled, on the ground and first floors, and an attic story above. The lower two rows of windows have mullions and transoms. The entrance bay is Renaissance, having a circular-headed doorway, with pilasters on both floors; see the plate by J. P. Neale, in vol. iii. of his "Seats," 1820. Sir Christopher Wren married, in St. James's Palace chapel, on February 24, 1677, Jane, daughter of the second Lord Fitzwilliam, as his second wife. Their daughter Jane was buried in the crypt of St. Paul's. Her epitaph is as follows:—

M.S. Desideratissimae virginis Janae Wren, clariss. dom. Christopheri Wren filiae unicae; paternae indolis, literis deditae, piae, benevolae, domisedae, arte musicâ peritissimae. Ob. 29 Dec. 1702: aet. 26.

Her mother was buried in St. Martin's-in-the-Fields on October 6, 1680. Marholm Church, which the family restored in 1868, contains many memorials of the Fitzwilliams; that of the first earl, *obiit* 1719, and his wife, is described as "by Jacob Fisher of Camberwell."

IN a "Note" on March 19 last we adverted to an offer made by Sir John Lennard, Bart., lord of the manor, to sell for 2,000*l*. his interest in West Wickham Common. At the close of a public inquiry, held last week, at Beckenham, by an Inspector of the Local Government Board, Mr. Tulloch, the Inspector, said he would report favour-

* Confer. the record, compiled, in 1565, by Hugh Fitzwilliam, of Sprotburgh, co. York.

ably upon a proposal by the Beckenham Local Board to contribute 100*l.* towards the purchase-moneys. It was announced that of the total 2,000*l.* asked for, private individuals had subscribed 1,200*l.*, in addition to 500*l.* by the London Corporation, who will, it is expected, formally open the ground in the course of this month.

MR. EDWARD WHYMPER'S little manual on "How to Use the Aneroid Barometer," will be much appreciated by those who desire to use the instrument with any approach to scientific accuracy. One of the first problems the author set himself was to ascertain whether the *means* of the readings of several aneroids would or would not accord with the mercurial barometer at low pressures, the idea being that the *plus* errors of some instruments might balance the *minus* errors of others; but it was soon found that each instrument indicated lower pressures than the mercurial barometer, and means of the whole were, consequently, less than the truth. From this it would follow that a great part of the altitudes throughout the world which depend upon observations of aneroid barometers made while ascending, must be too high, and that a general lowering of them will be found necessary. Mr. Whymper's investigations have extended over a period of eleven years, and the general results, as given in this little work, are of much importance, and should be carefully studied by engineers and travellers who have occasion to use the instrument.

THE Society of Engineers' "Transactions" for 1889, edited by their secretary, Mr. G. A. Pryce Cuxson, which has been lately published, will be found to contain many papers of professional interest. The President, Mr. William Newby Colam, in his inaugural address, congratulates the members upon not only the continued, but the increasing, success of the Society, there being at that date 448 members of all classes, an increase of 8 per cent. on the previous year. After giving a brief outline of the Society's work for the past year, the President described many of the large works that had been recently proposed or carried out in different parts of the world. There are many other instructive papers in this volume, contributed by men who have made a special study of the subject upon which they write; but the one by Mr. George Maxwell Lawford, on the "Drainage of Town Houses," which was followed by a good discussion, will probably most interest our readers.

A VERY interesting lecture on the proposed Nicaragua Canal was delivered before the Franklin Institute last January by Mr. Geo. W. Davis, the General Manager of the Company which has been formed to carry out the undertaking. The author points out that the physical features of the lake and river route by Nicaragua have been carefully studied in all their relations, and have been made the subject of plans thoroughly elaborated in all details, and of estimates carefully calculated; and competent engineers pronounced the project unembarrassed by any difficulty save that of magnitude, which, in this age, is a hindrance only when it advances the cost of construction beyond the limit of remunerative returns. The first complete instrumental survey of the route was made in 1850, but many others have been made since, and a large amount of knowledge regarding the country has been obtained. Commencing on the Atlantic side, the canal runs directly across low ground for the first ten miles, and must be formed by dredging, the soil being composed entirely of sand and clay. In the next three and a half miles there are three locks, and afterwards the canal traverses basins which are created by damming the streams which flow across the line. At about thirty miles from the Atlantic it enters the San Juan river, and for sixty-four miles there is free navigation, the river being wide enough to allow the largest steamers to pass each other at full speed. At the end of this river portion of the canal is Lake Nicaragua, across which there is clear sailing for fifty-six miles to the point where the canal leaves the lake upon its western shore. Only seventeen miles of canal is now required to reach the Pacific ocean, and, although there are three locks upon this length, there is no especially difficult work to be done. The total length of the route is 170 miles, which distance, allowing for the six locks, it is expected will be traversed in twenty-eight hours. To form the canal some 70,000,000 cubic yards of excavation will have to be done, and 10,000,000 cubic yards of embankments formed. The Company's estimate for the total expenses in carrying out this work is 25,000,000*l.*, which is about the amount the Suez canal cost, and they consider it will take six years to accomplish.

IN 1884 a building called Hampden House was established as a kind of residential club in the north-west of London, in order to provide young men of moderate and small means, employed in business in London, with a home where they would obtain congenial companionship. No object could have been more praiseworthy, for there cannot be a doubt that solitary lodgings are bad for the moral and physical health of very young men. This institution, if it may be so called, appears to have been so successful that the establisher of it, Mr. T. Eccleston Gibb, is now turning it into a limited company. Mr. Gibb is to receive from the company 10,000*l.* in shares, 60,000*l.* in mortgage debentures, and 60,000*l.* in cash, — in all a nominal sum of 130,000*l.*,—as the purchase money of the freehold property and the undertaking. Philanthropy would seem from this to be by no means an unprofitable kind of business. We observe that no valuation of the property of any kind is given in the prospectus, nor are we told what was the cost of the site and the buildings. We are far from censuring anyone for making money out of such a useful institution, but it would be more seemly, under such circumstances, to omit from the prospectus the blessings of divines on "this noble work." A good commercial return is quite sufficient attraction, and on the whole such institutions are most likely to flourish when they are undertaken simply and solely with a commercial object.

IT is to be wished that all the working men who are clamouring for a legal limitation of the hours of labour should know the little story in connexion with it related by a lady in a letter to the *Times* of August 30, of the labourer who came home in the evening and told his wife he had been at a meeting about the eight hours, and she was to make haste and get his tea. "Get it yourself," was the answer, "my eight hours is over." Eight hours politicians had better reflect a little on that answer; they will find it of rather wide application.

THE BRITISH ARCHÆOLOGICAL ASSOCIATION AT CARDIFF.

WE now resume and conclude our report of this Congress.*

The programme on Wednesday, August 24, was a very varied and enjoyable one, since it provided for a journey through some of the most beautiful scenery of the south portions of Glamorganshire, as well as for the inspection of many objects of interest. Proceeding along the main Roman road into South Wales, now represented by the modern thoroughfare from Cardiff to Newport, the picturesque village of St. Mellon's was passed, and a sight obtained, and no more, of its ancient church, standing on high ground. The first halt was made at the large old mansion of Cefn Mably, the seat of the Kemys-Tinte family. Here Mr. E. Seward briefly described the history of the fabric, from the period when a Norman castle was erected on the site to the time when the present house was erected. The defence of Cefn Mably during the civil wars was referred to, and the points of encounter indicated. Some traces of hasty fortifications had already been passed in the park. The mansion is a long building, worthy of the period of Queen Anne, with a large coved cornice of plaster, which extends around the fabric. Traces of Tudor work are visible here and there, but nothing of Norman date is apparent above ground. The gardens are very extensive, and were seen in their full summer beauty, and the house commands a superb view of the surrounding country and over the Bristol Channel. Within, the rooms have some admirable pieces of old furniture and tapestry, while the "Soldiers' Gallery" contains a table in part composed of a plank of oak, 42 ft. 8 in. in length by 6 ft. or 7 ft. in width, said to have been cut from a tree grown on the estate.

Under the guidance of Lord Tredegar, the party proceeded through Ruperra Park, and inspected some curious mounds, which face due south. They are surrounded by shallow ditches, and were pronounced to be funereal. One had been cut open for inspection, but the trenches revealed only a few fragment of charcoal, the opinion being that the excavation had not been carried down sufficiently deep. The journey was then resumed through the village of Rudry, along a hilly road in full view of a beautiful range of mountains, past the partially ruined mansion, The Van, to Caerphilly Castle. Here the party partook of luncheon in the ancient banquetting-hall, on the invitation of the Marquess of Bute. Afterwards the ruins of the Castle were described by Mr. Robert Draine, F.L.S., whose remarks were aided by a large plan. The fortifications were of great strength, and the system of defence was described. It was noted with satisfaction that by the Marquess of Bute's care a sufficient amount of pointing is being done to the walls, the massive nature of which, however, ensure the preservation of this fine ruin for many generations. After leaving the Castle, the progress was through the village of Nantgarw, once the seat of a well-known china manufactory, the site of which was pointed out. Castle Coch, finely seated on the side of a high hill, was also passed. It was restored from a very ruined condition from the plans of the late Mr. W. Burges, who designed the work for the Marquess of Bute, and it is now a complete specimen of a Mediæval castle of moderate extent.

Llandaff was reached late in the afternoon, and the party had but short time to be present at a garden-party given by Lady Hill. Only a passing glance could be given to the Cathedral, under the guidance of Mr. Coates Carter.

In the evening, papers of much interest were read at the Town-hall, the first being on "Early Christianity in Wales," by the Rev. H. Cart, in which many evidences of the planting of Christianity in the Principality were adduced, and the foundation of the Welsh Bishoprics traced. An animated discussion followed.

The second paper was on the "History of St. Fagans," by the Rev. W. David, who not only referred to the legendary history of St. Fagan, but traced that of the parish, concluding with a description of the battle between the Royalists and the forces of the Parliament.

In consequence of the extent of the programme of places to be visited, it was decided that the party should be divided for the work of Thursday, August 25.

Accordingly, one part of the company proceeded to inspect Cardiff Castle, which was thrown open for the purpose by the Marquess of Bute. Under the guidance of Mr. E. W. M. Corbett, the private apartments and the many art works were examined, and Mr. Godwin, in the library, pointed out the most remarkable of the literary works. The walls of almost all parts of the castle are richly decorated from the designs of the late Mr. W. Burges, but the ancient portions of the castle have been but little interfered with. The ruined keep still stands on its grass-covered mound, and the result of recent researches are apparent by the marking-out of many points of interest that have been uncovered. These are now indicated by the erection of new walling carried up to a certain height, and then discontinued. By this means, all the positions of drawbridges, curtain-walls, portcullises, and similar works of defence are clearly shown. During recent years it was ascertained that the enclosing banks of the castle-grounds, which indicate a well-defined outer ballium, in reality are heaped up above an ancient ruined wall of defence, there being towers at intervals.

* See *Builder*, p. 167, *ante*.

The work proved to be of Roman date, and for the first time it became evident that Cardiff had been a Roman station. The walling is much broken down, and the original height cannot be made out with certainty. But it is perfect at the base, and since the earth that has so long buried it has now been removed from the east side of the enclosure, by the direction of the Marquess of Bute, this portion is now revealed to view. It was pointed out by Mr. J. Storrie, Curator of the Cardiff Museum. A trench has also been carried through the bank which covers the inner face, and the thickness of the Roman wall has been ascertained to be about 10 ft. It is faced with blue lias stone, squared, and laid horizontally. The ruins of the Black Friars and the White Friars, both contained in the grounds or gardens of the Castle, were inspected, after which the Roman relics found at a villa at Llantwit Major were shown by Mr. Storrie in the Cardiff Museum.

The other party, under the guidance of Mr. Loftus Brock, visited Caerleon-on-Usk, or City of Legions, the site of the famous Roman capital of Britannia Secunda, and for many years the station of the Second Legion. By the courtesy of the authorities the museum was thrown open for inspection, and its collection of tesselated pavements, inscribed stones of the Second Legion, and many other treasures found on the spot, were examined. The church contains some portions of Early Norman architecture, built, probably, with Roman stones. The walls of the station are traceable here and there, there being sufficient to show that the enclosure was in the form of a parallelogram, 1,620 ft. by 1,380 ft. only in size, traversed by the Via Julia. The angles, where visible or traceable, are boldly rounded, and it was pointed out that one of these had been rebuilt at a later period, when pounded brick, not visible elsewhere in the walls, was used in the mortar of this portion. A hurried visit was paid to the huge mound which was thrown up at some later time over the walls of a Roman villa, which are thus buried in part beneath it. Afterwards, the amphitheatre, a construction of earth overgrown with grass, and popularly known as King Arthur's Round Table, was inspected.

In the afternoon the united parties proceeded to visit the Church of St. Fagans, where the Rev. W. David, M.A., pointed out the well-known and very beautiful geometrical windows, and some other features of interest. Progress was then made to St. Fagans Castle, an Elizabethan fabric of many gables, the entrance front being in the common form of the letter E. A remarkable fountain-base, in front of the entrance, attracted a good deal of notice. It is circular, of cast lead, and of large size, the decoration being very elaborate and good. Arms with many quarterings are mingled with scroll-work and arabesques. The date is 1620. Inside, the mansion has some good examples of carved panelling and plaster ceilings, one of the latter being repeated in a second apartment, and it occurs again in a hall in the vicinity. The garden front commands a very fine view, and the terraced gardens are of considerable extent. Thanks were rendered to Lord Windsor for permitting the house to be visited.

The party next proceeded through beautiful and very diversified scenery to the modern mansion of Mr. G. T. Clark, F.S.A., the eminent antiquary, at Talygarn, where a large company of ladies and gentlemen had assembled to meet them. Mr. Clark pointed out to his guests many of the numerous art-treasures of his house, among which some particularly good suits of armour were noted. Refreshments were partaken of, and an agreeable afternoon was spent, the party returning to Cardiff at a late hour.

Notwithstanding the delay occasioned by the late arrival, the evening meeting was held, and a paper was read by Dr. Phené, LL.D., F.S.A., entitled "Arthurian Necropoli." It was illustrated by a large number of photographs of almost all the sepulchral remains of prehistoric times in the county of Glamorgan.

Friday, August 26, was devoted to the exploration of some remarkable sites, memorable in the history of Early Christianity in Wales, and also a group of no less remarkable megalithic remains. Proceeding along the high road, more or less on the site of the Via Julia for a few miles, the party branched off to reach the Cromlech at Dyffryn, which, now denuded of the large mound which once covered it, stands out prominently to view. Its stones are of enormous size, and the prominence of its position renders it an object of unusual interest. But the Cromlech at St. Nicholas, at no great distance, is still more remarkable with respect to size, the top stone being the largest in Britain, the length being more than 24 ft. by about 13 ft. It is still partially covered by a mound of stones and earth, but sufficient has been removed to enable the interior to be inspected. Standing on the covering stone, Mr. Franklen G. Evans, J.P., F.R.A.S., gave a lengthy description of megalithic remains of all sorts and kinds, in various places, the notice of the actual remains before his audience being lost in his widely-extended remarks. The site, which is in part a fir-grove, is one really demanding careful survey, for remains of avenues, buried stones, traces of stone circles, cromlechs, and single stones are apparent in several places, showing apparently that here was a necropolis of very extended size, never yet surveyed with completeness. Llancarvan Church was at last reached, and Mr. O. H. Jones, J.P., of Fonmon Castle, pointed out the salient features of the fabric, some portions of which are supposed to be the work of Walter de Mapes. The site of a celebrated monastery, supposed by many writers to have been here, was more probably, in the judgment of the speaker, at Llanvithen, at no great distance. It is dedicated to Cattog the Wise. But, indeed, in respect to the dedications, almost all the churches visited during the Congress are dedicated to personages of early date, whose names are but rarely heard of elsewhere, except in Cornwall or Armorica. The reredos is a portion of what must have been a very fine rood-screen, the remainder of the lower portion being used as a screen to a south chapel. The junction of the two parts appears all but certain, although much discussion occurred with respect to it. At Llantwit Major, after having passed the fine cruciform church at St. Athans and the ruins of Boverton Place without stopping, the antiquaries proceeded to inspect the extremely interesting church under the guidance of Mr. Iltyd Nicholl, F.S.A. It consists of a western tower, formed on arches as a central tower, the aisles of the nave being flush with the western end. The chancel is capacious. To the west of the tower is a second church, having a south porch. To the west of this, again, are some attached buildings now in ruins. The western church has a very good open roof of oak sadly wanting present attention. It is not used for service, and is filled with peculiar coffin-shaped graves of a form common in the surrounding graveyard and in the others of the locality. There are also many curious effigies, and some of the interesting stones of early date, covered with interlaced work, which make this site so remarkable. One of these, a circular shaft rebated to occupy some position at an angle, is still in capital preservation. The buildings are full of curious features, each of which demanded longer attention than could be given to them, especially those which appear to be for monastic uses, although none of the masonry is of very early date. Several detached buildings also exist of similar Mediæval construction adjoining the churchyard, or within sight. The carriages being resumed, the party proceeded to visit Fonmon Castle, an early work, built about a century after the Norman conquest of Glamorgan, and remodelled in the middle of the seventeenth century when the property came into the possession of the ancestor of the present owner. Mr. Jones led the party into the hall, and gave a graphic, although brief, description of the fabric, and the descent of the property. It has been in the possession only of two families since it was erected, and it has always been occupied. Tea having been partaken of, the company made the perambulation of the castle, under Mr. Jones's guidance. The homeward journey was through the beautiful grounds of Porthkerry Park to the Barry Station, the ruins of Barry Castle being inspected. They stand on high ground, overlooking the Barry Docks, close to the present remarkable development which is rapidly creating a new town on this formerly barren spot. The hour being late, and a train having been missed, the loss of time was in some measure regained by Mr. Storrie's paper on the Roman Villa discovered at Llantwit Major, intended for an evening meeting, being read in the open air.

In the evening, Mr. J. P. Seddon's paper on "Llandaff Cathedral and its recent Restoration," was read, in the author's absence, by his partner, Mr. J. Coates Carter. This was followed by a description of some curious encaustic tiles by Mr. S. W. Williams, after which Mr. Fowler exhibited drawings of others of similar design, and the proceedings were brought to a close by the reading of a paper on "Llantwit Major, a Fifth-Century University," by Mr. A. C. Fryer, Ph.D., M.A. All the scattered notices of Iltyd's celebrated foundation were collected by Dr. Fryer, and reference made to the probable subjects of study, derived from ancient Roman civilisation.

Saturday morning, August 27, was,—for the first time since the beginning of the congress,—wet and gloomy, in harmony with the news of the terrible colliery explosion at Aberkenfig, which was on everyone's lips. The steady downpour, and the early hour appointed for leaving, caused but a few of the party to brave the elements, and but a small part of the programme for the day could possibly be carried out. Leaving the Queen-street Station at 8·20 during a fortunate lull, the archæologists proceeded along the beautiful valley of the Taff, in saloon carriages of the railway placed at their disposal, to Cowbridge, the intention having been to pay a visit to St. Donat's Castle, on the coast, and then to Ewenney. The continuance of bad weather, however, at Cowbridge, caused the first part of the programme to be abandoned, and it was finally decided to confine the day's proceedings to a visit to Ewenney Priory. Covered carriages having been provided, the party proceeded from Cowbridge along the line of the Roman Via Julia, and at midday Ewenny was reached. Here Colonel J. Picton-Turbervill welcomed the party, in the name of his sister-in-law, and conducted the members into the ancient priory, after having offered them hospitality in the modern mansion which stands on the site of some of the monastic buildings. The church is a remarkable building, Early Norman in style, although, as described by Col. Turbervill, its foundation dates from 1141, the church consisting at present of a large low central tower, a wide nave shorn of its western bay, a south transept, and a presbytery. Traces of the north aisle are visible, and also of the north transept and two chapels, as well as of two chapels to the east side of the south transept. The early style of the workmanship recalls the statement made by Leland that the actual building was erected in the early part of the twelfth century, and that it was only given in 1141 to Gloucester Abbey by Maurice de Londres. This may account for the early appearance of the work here, but it is worthy of remembrance that Margam Abbey presented to the visitors equally early Norman work, although the date of foundation is there a few years later, with the record that the site was originally elsewhere. This was a fortified monastery, and, after inspecting the church, their guide conducted the visitors to two of the towers which defended the walled enclosure. There is a third, used later as a dove-cote, and in addition two interesting gate-house towers, one of which is in perfect condition. These date from Edwardian times. The nave of the church is now used as the parish church, and is separated from the transepts by the lower part of the rood-loft wall, in which are doors of entry and exit, showing that, if used originally for parochial services, it did not cease to do duty for monastic processions. The roofs are for most part wooden and poor, but the chancel is vaulted in low, heavy Norman style, needing attention at no remote date. The floriated slab forming the founder's tomb is of great beauty, and in admirable preservation. Fine weather again favoured the party before the interesting and but little known priory was left behind, and Cowbridge was reached in comfort.

The closing meeting took place in the Town-hall in the evening. Papers were read by Mr. W. H. Cope, F.S.A., on "Cambrian Pottery and China," and by Mr. Loftus Brock, F.S.A., on "A Comparison of the Roman Stations of Caerwent, Caerleon, and Cardiff," in which he pointed out that while almost always in England walled towns were found only at the end of main roads, here were three walled enclosures in a series, while there was probably a fourth at Cowbridge.

Hearty votes of thanks were proposed by Mr. Alan Wyon to Dr. Vachell, Chairman of the Local Committee, to Mr. E. Seward, its Secretary, and to all the noblemen, gentlemen, and ladies who had been so profuse in their offers of help and hospitality.

The Congress thus brought to a close has been one of the most interesting and successful held by the Association in recent years. It has been very well attended.

ALTERATIONS TO THE PONTE ST. ANGELO, ROME (PONS ÆLIUS).*

"Come i Roman, per l' esercito molto,
L'anno del Giubbileo, su per lo ponte
Hanno a passar la gente modo tolto;

Che dall' un lato tutti hanno la fronte
Verso 'l Castello, e vanno a Santo Pietro,
Dall' altra sponda vanno verso 'l monte."
Dante's Inferno, Canto 18, *l.* 28.

THE pilgrims of 1300, to whom Dante compares the coming and going of the sinners in the Eighth Circle of his Inferno, have themselves contributed to lower, to sink out hollows, and to round with the shuffling of their shod or unshod feet, the masses of travertine forming the foot-paths of the Bridge of St. Angelo, held together with cramps and dovetails, as well as to wear the great blocks of lava with which the Emperor Hadrian had the great bridge paved, which joined his Mausoleum with the Campus Martius; "the handsomest and most convenient of Rome." Footpaths and pitching are just opened out to leave free passage to the new great wall of the Tiber side, and are only opened out to be destroyed; for the great wall of the Tiber, in regard to the Roman monuments it comes across, is what the lava of Etna is for the vineyards of Nicolosi. Nor are the footpaths and the pitching of the bridge of St. Angelo the only things to fall under the pick of the demolishers; the pickaxes and hydraulic levers of the engineers will descend and demolish the arches now opened up under the paving, and there will be built in their place, on one side, an arch equal to one of the three centre ones, while another will be constructed on the opposite side of the bridge against the castle.

This being done, the bridge of St. Angelo will lose its characteristic appearance, and instead of regaining its primitive aspect, will give us a bridge with five equal arches above a yellow ditch, the consequence of silting up. The medal in the Louvre, illustrated by Donaldson, shows what the bridge originally was, with its grand central arches to give passage to the ordinary water of the river, and with smaller arches on both sides for floods.

To have an idea of what the Tiber becomes under conditions to which it is now to be reduced, it suffices to stand on the Garibaldi Bridge, and to look towards the Island of St. Bartholomew, the island that Livy tells us was formed by the harvest of the lands of Tarquin the Proud, thrown into the river by the people who drove him from Rome. Here afterwards rose a temple to Æsculapius, and the whole island was margined with carved marble in the shape of a ship, in memory of the one that brought from Epidaurus the God of health.†

The *Isola Tiberina* is now a peninsula, as it is joined to the shore by a vast sand-bank; in which ghastly rivulets are lost by absorption, or large pools of stagnant water putrefy after every little flood. The engineers of the Tiber have made a wooden dam opposite a pier of the Garibaldi Bridge, to turn a little water towards the sand-bank, but without effect; for, besides having neither noticed nor respected any part of the characteristic and noble aspects of the sacred river, they have not known how to avail themselves of that mastery of the waterway which Roman monuments show in the case of bridges. The Bridge of St. Angelo is one of these masterpieces; the great central arches were made to keep the bed of the river in ordinary times covered with water, and the side arches to give passage to floods, and thus form an architectural whole, the material result of needs provided for by the experience of ages.

It seems impossible that modern hydraulic science should so lag behind that it can give no better solution to this problem. The problem is to adapt this antique bridge to modern requirements. The solution proposed is to pull down the subsidiary arches, and make them identical with the principal ones, so that the bridge will then only pass over a muddy and sandy canal, and not over a tawny river.

THE ARCHITECTURAL ASSOCIATION.—As will be seen by an advertisement which appears on p. xx, the visit to St. Albans, which was announced to take place this Saturday, September 3, is postponed until Saturday, October 1.

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* Translated from an article in the *Riforma*.

† "What remained of the giant ship," writes Professor Middleton of Cambridge in his "Remains of Ancient Rome," "was lately destroyed in the grand alteration of the banks of the Tiber, which has greatly helped to destroy the beauty of this part of Rome. The very form of the island was altered, and little now remains of that which was one of the most picturesque and interesting of Roman views."

RIVERS POLLUTION AND RIVERS PURIFICATION.

MR. H. A. ROECHLING, Assoc.M.Inst.C.E., in a paper read by him at the recent meeting at Bury of the Incorporated Association of Municipal and County Engineers, said that England is rightly looked upon as having taken the lead in the question of practical sanitation; but it is equally true, on the other hand, that it is from England whence the outcry about the pollution of streams and rivers arose. There is no town or village that is not confronted with the solution of this complex problem, which presents a somewhat new aspect in every case, and it was in connexion with proceedings against his Town Council for the pollution of the river Soar at Leicester that the author of the paper was for the first time brought face to face with what was in that case an embarrassing problem.

The question of the pollution of our rivers is by no means a modern one, and does not date from the introduction of the system of water carriage of all fæcal matters. It is well known that in all parts of the globe the rivers and streams were looked upon for centuries as the medium for conveying away the filth and refuse of which communities wished to get rid. No doubt as long as the population on the banks of a river remained small, this did not cause a serious pollution; but when the towns increased in size and population, the nuisance such a course entailed became more and more serious, till at last it became an absolute necessity to take all the refuse and filth out of the river and provide other channels for it. This was the commencement of the systematic drainage of towns, which was intended to prevent the pollution of the subsoil of houses and streets, and to keep the rivers and streams within the town free from polluting influences. It cannot be denied that by the introduction of a proper and well-maintained system of sewers and drains for carrying away all refuse water and fæcal matter the first object has been attained, viz., the keeping of the subsoil clean; but as to the second object, the author is afraid that it has not been achieved in all cases. There are towns which purify their sewage, and which cause no pollution in the stream that takes the effluent, and there are others which cause serious pollution. It does not follow, however, that the first set of towns spend more money on sewage purification and purify their sewage to a higher degree than the second set, the sole cause in the difference of results being in some cases the river, into which the effluent goes. Some rivers seem to be able to deal successfully with any amount of sewage, others seem to turn sick at the smallest dose. There are, of course, other causes of pollution besides town sewage, such as the waste liquids from mills, factories, mines, &c., but as they are not of such general importance they will not be here considered. It is this different behaviour of the rivers that it is the author's intention to investigate and to throw, if possible, some light upon what has been called the self-purifying power of a stream. For this purpose the author does not intend to confine himself to English rivers only, but purposes to review American, French, and German rivers as well, so as to give a complete survey of the present state of our knowledge of this question.

It will, of course, be admitted that no town has a right to keep its subsoil clean by a system of drainage and to dispose of its filth to the disadvantage of perhaps smaller communities lower down the stream by polluting it; but, on the other hand, it will equally be admitted that a town has a right, after effective treatment, to turn the effluent from its sewage works or sewage farm into the river on the bank of which it is situated; the degree of effectiveness of such treatment must be the state of the river after it has received the effluent. If the river is turned into a black boiling mass of putrefaction by the effluent, the purification of the sewage is said to be a failure, but if it is left sweet and pure after proper admixture, we look upon the treatment of the sewage as successful. It is the river that decides the degree of purification which must be attained by the sewage treatment, and in this respect any well-considered scheme of sewage disposal or sewage utilisation must start from the purifying powers of the river into which the sewage effluent is to go. The author is afraid this point has been overlooked in a good many cases, and rivers have been called upon to do work for which they were utterly unfit, hence their pollution. It may not be possible in all cases to preserve the river water below large towns in that state of purity which it possesses near its source, but it is absolutely necessary to prevent its systematic pollution, be it by the effluent from sewage works, or by the waste liquids from mills, factories, &c. In this respect the author cannot but think that it is a wise course to tap rivers near their source for the supply of large towns, and not to rely on river water, as is the case in London, that has swallowed the sewage of a population of something like a million residing in 202 towns and villages.

Previous to 1866 this question had not received official attention, and it was left to chemists such as the late Dr. Letheby to study the question in connexion with sewage disposal works. In that year, however, owing to the complaints about the bad condition of some rivers becoming louder and louder, a Royal Commission was appointed to investigate the cause of river pollution, and to suggest remedies. It issued two valuable reports, and was succeeded in 1868 by a second Rivers Pollution Commission, which sat until 1874, and issued six lengthy reports. Since then this question has been repeatedly studied, both at home and abroad. Notable amongst these investigations are those made by the Massachusetts State Board of Health on the rivers within its territory, by the French Commission of 1874 on the Seine at Paris, by Brunner and Emmerich, 1874-75, and also by Prausnitz, 1887-88 and 89, on the Isar at Munich; by Hulwa, 1877-81, on the Oder at Breslau; by Frank, on the Spree at Berlin, 1886-87; by Celli and Scala on the Tiber at Rome, 1890. The late Dr. Tidy has also gone very fully into this question, and read two elaborate papers in 1880 and '81 on this subject before the Chemical Society.

In order to give some idea of the composition of town sewage, the author has prepared a table in which he has compared the sewage of several European towns; the sewage of these towns does not vary very much from the average composition. In another table the sewage of water-closet towns and midden towns is compared, and there is not much difference between them. This has been done to disprove what is sometimes asserted, viz., that the whole difficulty of sewage purification would be practically non-existent were the fæcal matters kept out of the sewers, and only the waste water from houses and the rain water carried away in them. A third table gives some analyses of waste liquids from mills and factories, from which it can be seen at a glance that these wastes are far more powerful sources of pollution than ordinary town sewage. The influence towns exert upon a river that flows through them can be learnt from another table. In the case of Bradford, for instance, the beck below the town contained in 1869 over ten times as much ammonia and organic carbon as it did above the town, and nearly five times as much organic nitrogen. In Leicester, too, the Soar below the town was, in August, 1884, seriously polluted, though not to the same extent as the Bradford beck. A great number of similar cases might be quoted, but the three stated will suffice to give some idea of the deterioration of river water in its passage through populous towns.

Tables V. to XXI. contain analyses of the following rivers:—

Table.	River.	Country.	Name of Analyst.
A.—V.	Thames	England	Rivers Pollution Commission
VI.	Ditto	"	Dr. P. F. Frankland
VII.	Mersey	"	Rivers Pollution Commission
VII.	Irwell.....	"	Ditto
VIII.	Soar	"	Dr. Tidy
IX.	Severn	"	Ditto
X.	Shannon ..	"	Ditto
XI.	Ure	"	Dr. P. F. Frankland
XI.	Ouse	"	Ditto
B.—XII.	Blackstone River	N. America	Massachusetts State Board of Health
XIII.	Charles River	"	Ditto
XIV.	Merrimack River	"	Ditto
XV.	Beaver Dam Brook	"	Ditto
C.—XVI.	Seine	France	Commission of 1874
D.—XVII.	Spree	Germany	Frank
XVIII.	Isar	"	Prausnitz, &c.
XIX.	Elbe	"	Board of Health
XX.	Oder	"	Hulwa
XXI.	Nebel.....	"	Heyroth

It will be noticed that some of the rivers of which analyses are given have tidal portions, and it is necessary to state here that in the investigations for this paper these portions are not included. The reason of this is not far to seek, the conditions in the non-tidal portions being so different from those in the tidal portions that it is impossible to combine them in one set of investigations and to arrive at combined conclusions; and as the consideration of a non-tidal river is of far more general importance than that of a tidal one, the author only deals with the former class of rivers in this paper, leaving the examination of rivers that are tidal for a future occasion. It was not possible in all cases to give particulars concerning the velocity and discharge of the river under review, and the author regrets that sometimes elaborate analyses of a river at various points of its course are given without any attempt to convey some idea as to its discharge at these places, and as to the quantity of sewage that is poured into it. No definite conclusions can be arrived at without a full knowledge of these factors.

To judge of the state of any river it is usual to note its state as it appears to the naked eye, and to take samples of the water for chemical, microscopical, and lately also for biological examination. In the incipient stages of pollution it is difficult sometimes to detect it with the naked eye, but when the pollution has advanced further, the turbidity of the water, its colour, and smell are sure indications of it. The chemical examination should be carried out as soon as possible after the samples have been collected, otherwise further changes in the water will take place, and it cannot be said to express the various degrees of pollution so clearly as the biological one, which gives the germs per cubic centimètre. This can be seen very clearly from the analyses of the water of the Spree at Berlin, and of the Nebel near Guestrow. In the case of the Spree, for instance, the amount of oxygen consumed lies between 1·69 and 2·30 parts per 100,000, whereas the number of germs discovered ranges between 6,141 and 329,905 per per cubic centimètre. In this country it has not been customary up to the present time to examine water biologically, but on the Continent and in America the biological analysis now generally accompanies the chemical one.

The late Dr. Letheby stated before the Royal Commission on Water Supply in 1869 that he had made a very great number of chemical experiments to determine the self-purifying powers of our rivers and streams. He had also examined most of the rivers in England, and the conclusion he had come to was this, that if ordinary sewage containing, say, nearly 100 grains of solid matter per gallon, such as the London sewage, out of which probably something like 14 or 15 grains were organic, be mixed with twenty times its bulk of the ordinary river water, there would, after a flow of a dozen miles, be not a particle of that sewage discovered by any chemical process. The late Dr. Tidy, who at one time was assistant to Dr. Letheby, held very similar opinions, and, in a paper read some years ago at the Chemical Society, he stated that if sewage be discharged into running water the organic impurities would, after a flow of a few miles, be entirely destroyed or got rid of, the water once again assuming its normal condition of purity. He was of opinion that this power of self-purification depended on the subsidence of the suspended matters, on the presence of animal life in the river, and on the oxidation of the organic matter. The second Rivers Pollution Commission, after having investigated the case of the Irwell, Mersey, and Darwen, which were at the time the examination was made highly-polluted streams, and the case of the Thames, and after having made some laboratory experiments, came to conclusions somewhat opposed to those held by the late Drs. Letheby and Tidy; for whereas these two gentlemen were of opinion that both the suspended impurities as well as the dissolved organic matter,—the former by subsidence, the latter by oxidation,—were completely removed after a certain length of flow, the Commission held that though the flow of a river had a most material influence in the removal by subsidence of a large proportion of the suspended impurities both organic and mineral, especially if the flow was sluggish in places, yet the oxidation of the organic matter proceeded with extreme slowness even when the sewage was mixed with a large volume of unpolluted water, and that it was impossible to say how far such water must flow before the sewage matter became thoroughly oxidised,—in fact, it would be safe to say that there was no river in the United Kingdom long enough to effect the destruction of sewage by oxidation. On the Continent of Europe the opinions on this question are very similarly divided. It was the author's privilege to take part last year in the deliberations of the German Association for the Promotion of Public Health, and he had the pleasure to listen to a long argument by the veteran German sanitarian, Prof. Dr. Pettenkofer, in favour of the total annihilation of sewage in river water when the amount of water in the river was never less than fifteen times that of the sewage, and the velocity of the former at least equal to that of the latter. The Prussian Government and that of several of the minor States appears to have been guided at first by considerations proceeding from views similar to those expressed by the Rivers Pollution Commission, but latterly a change of opinion in this respect is noticeable, and more weight is attached to the opinion of Prof. Pettenkofer.

It cannot, of course, be denied that almost any river some miles below the point where it has received polluting liquids looks fairly clarified again, the distance in each case depending mainly on the degree of dilution; but it does not follow by any means that the river has purified itself during this length of run. All those who are endeavouring to purify sewage either by artificial or natural means will know that there is practically not much difficulty in getting rid of the suspended matters, and that the main difficulty lies in the removal of the dissolved organic pollution. Of course there can be no such thing as self-purification if the organic pollution remains in the river, and it is with reference to this point that opinions differ so materially.

The author will not attempt here to give in full his examination into the rivers in various countries of which analyses are given in the appendix to his paper, as with the aid of the tables any member wishing to do so can follow this course. Suffice it to say that the whole of the rivers were examined and due consideration given to each case, and that the following conclusions were arrived at:—

1. That rivers possess self-purifying powers.

2. That these powers are in the main limited to the sedimentation of the suspended matters and germs.

3. That though rivers do possess the power to oxidise the organic matter in them, yet owing to this power being small the process is a slow one; and

4. That the distance over which the process of self-purification goes on depends chiefly on the velocity of the river and the quantity of water flowing in it (degree of dilution).

These conclusions should not, however, be taken as final, as there is undoubtedly a great deal of further information required before this subject can be considered to have been exhausted. It is necessary that all the public bodies charged with the care of our rivers and streams should make complete examinations of the rivers, &c., within their district, somewhat after the manner followed by the Massachusetts State Board of Health. Such examination should extend over the period of twelve months at least, and should comprise, beside careful chemical and biological examinations of both the water in the river at different points of its course, and the sewage and waste liquids which it receives, exhaustive inquiry into the drainage area of the river, its geological formation, its rainfall, its population, the velocity and the discharge of the river at the points selected throughout the year, and the amount of polluting liquids poured into it. Such investigations will at the same time afford valuable information concerning the question of the water supply to towns. In this respect the present Royal Commission on the Water Supply of the Metropolis is collecting valuable information concerning the Thames.

From the conclusions at which the author has arrived it will be seen that they lie somewhat midway between those expressed by the Rivers Pollution Commission and by the late Dr. Letheby.

There are undoubtedly rivers which purify the sewage within a very short distance, and there are others where the river cannot right itself for miles. The former is the case where the degree of dilution is a very high one, *i.e.*, where the quantity of sewage is only a very small fraction of the flow in the river; the latter is the case where the sewage does not get much diluted by the river water. But wherever a river receives more sewage than it can deal with, it almost loses its power of self-purification.

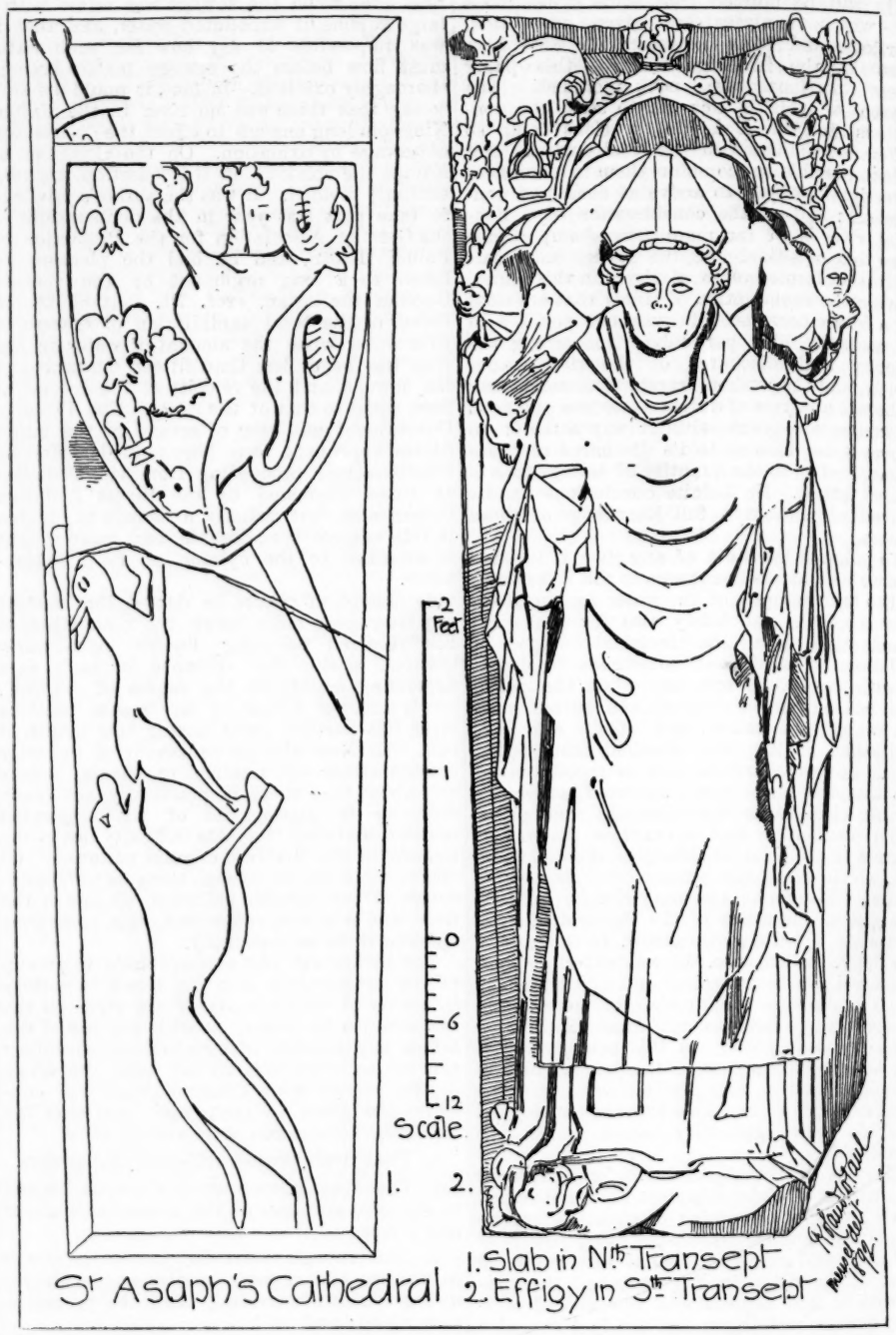
Prof. Pettenkofer proposes that the city of Munich should use the river Isar experimentally as a sewage farm. The drainage scheme for Munich was designed by the late Mr. Joseph Gordon in such a manner that the sewage, if required, can be applied on land without the aid of pumping. It is now proposed to establish a few roughing filters near the river to take out all floating matter, and then to let the raw sewage go into the Isar. If it can be proved at any time that such a course is fraught with danger to the river and the communities lower down its course, then the present outfall can be used as a storm overflow and the sewage treated on land. The population of Munich now amounts to 285,000, and when completely sewered the maximum flow of sewage will amount to about 35 cubic feet per second. The discharge of the Isar at low water is about 1,400 cubic feet per second, and its velocity at this time 4 ft. per second. In this instance the sewage amounts to 2·5 per cent. of the flow in the river at low water, and Prof. Pettenkofer, after having investigated the case thoroughly, is sanguine that no pollution will ensue in this particular case. It is quite impossible in the present state of our knowledge to lay down a general rule as to the degree of dilution which marks the boundary between the permissible and the non-permissible quantity of sewage, as this will have to be ascertained for each river in particular, the conditions varying in each case. It has already been stated that Prof. Pettenkofer is of opinion that if the sewage does never amount to more than one fifteenth, or 6·7 per cent. of the river water, and if the velocity of the latter is at least equal to that of the former, then raw sewage may be poured into such river without causing pollution.

In America, Mr. J. P. Stearns, Engineer to the Massachusetts State Board of Health, who has written a very able report on this subject, came to conclusions from which the author has deduced the following. If the sewage amounts to more than $\frac{1}{40}$, or 2·5 per cent. of the quantity of river water, it cannot be discharged into the river in its raw state; if it amounts to less than $\frac{1}{40}$, or 2·5 per cent., and more than $\frac{1}{130}$, or 0·8 per cent., it is doubtful whether it may be admitted; but when the sewage amounts to less than $\frac{1}{130}$, or 0·8 per cent. of the river water, then it may be admitted without any doubt in its raw state into the river. Stearns adds that these considerations are made from the "standpoint of the offensiveness of the water." From other standpoints, however, such as the use of water for certain manufacturing purposes, the amount of dilution should be greater; and in a stream used for domestic water supply it cannot be said, with our present knowledge, that any degree of dilution will make the water entirely safe for use.

In this country the results obtained from the discharge of raw sewage into the rivers have been very disastrous, the population of our towns being large, and the flow in the rivers small compared with the Continent and North America. After much careful consideration the late Commission on the Metropolitan Sewage Discharge came to the conclusion that in England it was not safe to turn even the effluent from chemical works into a running stream which did not carry twenty times more water than sewage.

The question of keeping our rivers pure and sweet is one fraught with many difficulties, which ever increase from year to year, and those who are responsible for their state have by no means an easy task both in this country and abroad; and as this is, in the author's opinion, an international question, he has thought it might be of some interest to this Association to have besides information from home, some from other parts of the globe bearing upon it.

THE NEW GUILDHALL, GLOUCESTER.—We are asked to mention that Elliott's patent "Simplex" weather-bar was used throughout to the casement windows of the new Gloucester Guildhall, the opening of which was recently chronicled in our columns.



Illustrations.

BANGOR AND ST. ASAPH CATHEDRALS.*

NEITHER of the two northern Welsh Cathedrals are conspicuous for their interest as episcopal fabrics, either in scale or detail. They are surpassed in both by many parish churches in England, and even in the Principality itself. The chief interest of Bangor lies in its plan, that of St. Asaph in its position, and in both will be found interesting monuments. Much as restoration has been abused,—and Bangor has come in for its share of abuse,—we owe much of the elucidation of its history to the repairs and partial rebuilding to which it was subjected under the direction of the late Sir Gilbert Scott. It was up to that time in a deplorable state, as were the other Cathedral establishments of Wales, and if we in these later days cannot always agree with all that has been done, we can and must at least bear tribute to the great care which was taken to found, as far as possible, the new work upon what had gone before, in preference to a new and original rebuilding, which could have been at that time of the Early Gothic revival hardly a success.

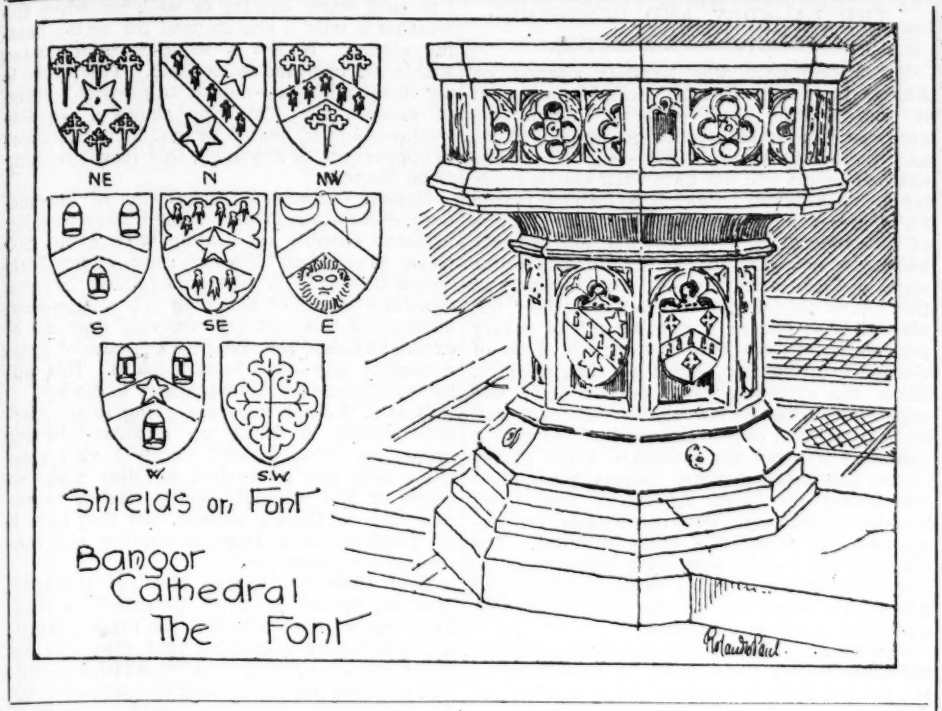
BANGOR.

Of the Norman Cathedral, destroyed during the wars of the Edwardian period, we have only one visible trace at present,—namely, a window and buttress on the south side of the presbytery. The restoration, however, revealed to a greater extent the dimensions of the Norman building, and by reference to the ground plan here given,—which, with other information, has been kindly put at our disposal by Mr. J. Oldrid Scott,—it will be seen that the position of the central tower, the length of the transepts, and the lines of the presbytery and apse, were all determined.

The church which arose on the ruins of the Norman structure in the fourteenth century followed to a great extent the lines of its predecessor. The central tower was of similar dimensions,—the old foundations being used,—and the transepts and eastern arm lengthened. The original extent of the Norman nave is now uncertain. The fourteenth-century one had aisles, which the Norman one probably had not, and on the north side of the presbytery a chapel was built, equal in length with it, and approached both from it and the north transept. To Bishop Anian (1267-1305) is due this rebuilding, and of his church some considerable remains have been found. For in the troublous times of Owen Glendower the Cathedral was a second time attacked and almost entirely destroyed, and the vestiges of Anian's church which are now visible are due chiefly to the remains which were found during the restoration, and which have been taken as a guide for, and incorporated with, the new work of the transepts. The presbytery walls, the shell of the north chapel, and the aisle walls of the nave are largely Anian's work in all probability, although there seems some doubt as to the latter; but the jambs of the great windows of the transepts found during the restoration are of his time, and that on the northern side is especially worthy of notice for its detail,—simple but well proportioned. On the east side of the south transept was an aisle or, perhaps, a sacristy, the foundations of which were unearthed, but which has not up to the present time been rebuilt. This south transept, the nave aisle wall, and the Norman window and buttress before alluded to, are shown in our view, taken from the south-east. It was not until the end of the fifteenth century, three parts of a century after its second destruction, that the fabric of Bangor was again taken in hand. To Bishops Deane and Skevington we owe the Perpendicular work in the presbytery and the nave and western tower. Deane's work is perhaps represented by the better class of work at the east end of the presbytery, and the nave arcade, while his successor Skevington may be credited with the clearstory of the nave, and the windows of similar type on the south side of the choir. The west tower, over its western entrance, also bears the following inscription:—"Thomas Skevynton, Episcopus Bangorie hoc campanile et ecclesiam fieri fecit a° partus virginei 1532."

The Civil War left its mark on the fabric, and the modern fittings and absence of stained glass show how completely all that was of value had been destroyed. Of the period between the Civil War and the restoration by the late Sir G. G. Scott in 1866, perhaps the less said the better. It was a period during which the fabric was allowed to become degraded architecturally, and any interesting features of the sixteenth century that might otherwise have been preserved, gave place to the "execrable gimcrack" to which Scott alluded in his report to the restoration committee. The interior was put into thorough repair; the aisles of the central tower and the transepts

* This series of illustrations of the Cathedrals of England and Wales was begun in our issue of January 3, 1891. A list of those already illustrated, with particulars of future arrangements, will be found on page xx.



almost entirely rebuilt, the fragments of Anian's church being worked into the latter; and new stalls, pulpit, &c., took the place of the eighteenth-century excresences. The stalls are placed in their old position east of the tower, the two three-light windows high up in the south wall (shown in our view) having been placed here in Perpendicular times to light the choir above the stallwork, while the eastern portion of the presbytery was lighted by a larger window of five lights placed at the more ordinary level.

The central tower, which, if rebuilt in the sixteenth century, was destroyed completely, has not been rebuilt, and it is doubtful whether the foundations would bear the additional weight. The dignity of the fabric would be much increased by this feature, Skevington's west tower being but a poor one for a cathedral church. After the detail of Anian's church the chief interest of the building lies in its interior. During the rebuilding of the aisle or chapel north of the choir, some interesting discoveries were made. It was found that there had been more than one floor,—and fragments of these, including tiles of curious pattern with animals and birds incised, were unearthed, and are now to be seen at the west end of the north aisle, where they have been relaid in the floor. Standing against the wall near to them is a curious slab with an incised female effigy and inscription. It was discovered in the same portion of the building as the tiles, against the north wall of the chapel, and near its east end. It is composed apparently of a fine grey limestone, and bears the following fragmentary inscription in Lombardic characters:—

HIC · JACET · EVA · QVE · FVIT UX [OR] ANWELL · CVJVS · ANIME · PROPICIET(UR) (DEVS).

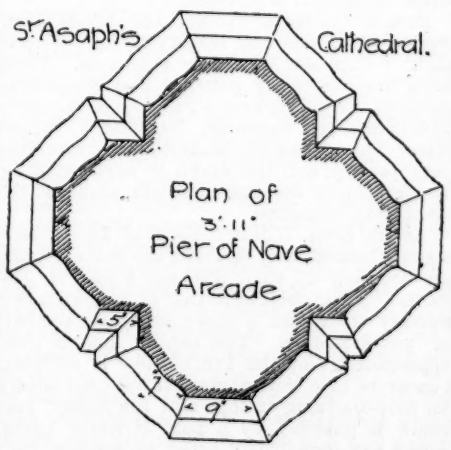
The effigy is an interesting study in costume, and in good preservation.* A rosary hangs over the left arm, and the head, resting on a pillow, lies under a cusped canopy, the carving in the spandrels being in the form of fleurs-de-lis. The space between the canopy and the pillow and shoulders is curiously powdered with four-leaved flowers, giving a much richer effect to the whole. The drawing of it here given is from a carefully-measured drawing made from the original. As it lay almost immediately north of the altar in the chapel, it must have commemorated some one of importance.

The two sepulchral arches on either side of the choir, shown on the plan, are now hidden by the stalls. The tomb in the south transept is of plain character, with a cross slab lying on the top, and a rough crucifixion built into the wall at the back. At the west end of the south aisle is the font, a good fifteenth century example, the panels of the shaft being elaborately decorated with various shields of arms, which are here given. Close by in the nave arcade are traces of an earlier respond. Another respond was discovered at the east end of the same arcade, and, though now covered, is shown on the plan, and points to the existence of an earlier arcade than that at present existing.

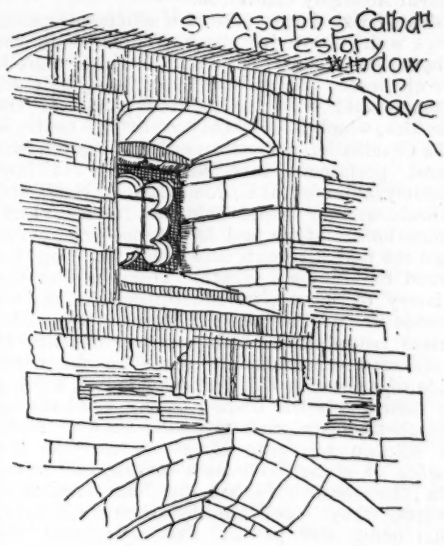
* The slab measures in its present state 5 ft. 8 in. in length and 1 ft. 11 in. in breadth at the top, the bottom being 2 in. narrower.

ST. ASAPH.

The Cathedral of St. Asaph, although a slightly smaller building than Bangor, and the smallest of the Cathedrals of England and Wales, is finely situated on rising ground between the rivers Clwyd and Elwy. Of the four Welsh Cathedrals it is the only one built on an elevated site, and it derives a great deal of extra dignity from its position. No traces of an early building are to be found here, and the fabric as it stands now is, with the exception of the modern eastern arm, entirely the work of the Decorated period begun by Bishop Anian at the end of the thirteenth century, and probably completed in the early half of the fourteenth century. The early church was destroyed in 1282, and the only vestiges we have were found during the rebuilding of the chancel, and consisted of portions of the side walls and window jambs. They were of thirteenth-century date, and it is probable that on Anian's return to his See, after his excommunication, his rebuilding did not include the choir, but commenced at the transepts and tower. It will be noticed that the eastern arm is not central where it abuts on the tower, the distance between the north jamb of the eastern tower arch being less than that on the south. The centre of the east window is, however, central with the tower arch, so that but little deflection is noticeable in the interior. A chapter-house stood on the north side of the choir, and a door which probably led to it was found during the restoration. This building would correspond in position with the north chapel at Bangor (now used as chapter-room and library), and had an upper room. The general plan of Anian's church was extremly simple; aisleless transepts, a central tower, and a nave of



five bays with aisles. The arches throughout have continuous imposts, the moulding of the column being continued round the arches without a cap. The mouldings throughout are of the simplest, merely consisting of a series of chamfered orders relieved with a wave moulding. This applies to tower arches, nave arches, and western doorway. The window tracery is reticulated in pattern in the transepts, with a more elaborate triplet, under an enclosing arch, at the west end. The side windows of the aisles are modern, but those at the west end are old, of two lights, with a quatrefoil in the head. Over the arcade is a clearstory of square



windows foliated, one window in each bay; old on the south, modern copies on the north. On examining them inside, it will be seen that the windows were originally of larger dimensions, the old marks of the sill being clearly visible (see sketch). In the north transept was an altar, in the south transept, which was the Lady-chapel, there were two. The north transept is now used partly as an organ-chamber and choir vestry, and the south is devoted to the uses of a chapter-house and library. In the centre rises the great central tower,—a massive bit of work, 40 ft. square, and, with the exception of the window tracery and the battlemented parapet, totally devoid of ornament. The stair turret is placed at the north-east angle. This central feature gives much additional dignity and completeness to the fabric, and increases the regret at the absence of a similar feature at Bangor.

Almost the only details of interest in the interior of the church are two monuments, of which we here give careful measured drawings. They were formerly on either side of the choir, near the east end, but were removed to the transepts when the eastern arm was rebuilt by Sir G. G. Scott. The first, a coffin-shaped slab, measuring over 7 ft. in length and 14 in. in thickness, lies in the north-east corner of the north transept. At the upper end is a shield bearing the arms semée of fleurs-de-lis, a lion rampant, and placed diagonally, passing under the shield, is a sword. The lower part of the slab is partially occupied by a hare chased by a hound, incised in a somewhat rude, if vigorous, style. In the south transept is a memorial of far higher artistic excellence, a figure of a bishop, finely executed, lying under a trefoiled cusped canopy flanked by pinnacles. It is somewhat remarkable in having had four angels, two with censors above the canopy, and two others guarding the pillow. The right hand of the effigy was held up in benediction, the left holding the crozier, but hands, crozier, and the heads and arms of the angels have been broken away. It is curious that the face has remained in such perfect condition, considering the evidences of past injury which the monument shows. It is generally supposed to represent either Bishop Anian or Llewelyn-ap-Ynyr (de Bromfield, his successor), and the details of the monument may very well be ascribed to that date. It is now in an erect position against the wall in the north-west corner of the south transept, where shown on plan, a good position for seeing it and for safety, but as a recumbent effigy its erect position is a little out of keeping. It should be restored to the choir, in which there is ample space.

The stalls are good late Perpendicular work of Bishop Redman's time (1471-1495), and have been added to and restored, together with a new throne and pulpit. The font retains portions of the old bowl, but is otherwise modern.

DECORATIVE FRIEZE IN THE CHURCH OF THE ANNUNCIATION, CHISLEHURST.

THE eight figures forming the portion of a frieze of sixty-four figures which go around the triforium stage of a part of the Church of the "Annunciation," Chislehurst, are intended to represent Eve, Sarah, Rebecca, Leah, Rachel, Rahab, Jael, and Judith. The drawing from which the illustration is taken was exhibited in the "Black and White" Room at this year's Royal Academy exhibition.

This frieze forms part of a scheme of paintings which have just been completed in the chancel of the above church. Perhaps there is no chancel in England more completely painted. Commencing with the painted panels of the reredos, which is of alabaster, in the centre is the Crucifixion, and surrounding it are the four most prominent sacrifices of the old law, namely, those of Abel, Melchizedek, Noah, and Abraham. On either side are further representations of type and ante-type,—*e.g.*, Moses and the burning bush, and Isaac carrying the wood for his own death. There is also the history of Joseph, as illustrating the various scenes in the Passion and Resurrection. The frieze between the string-courses consists of holy men and women. Those on the north side represent the Old Testament saints, holding in their hands the distinguishing emblems by which they are most generally known. Noah is holding an ark, Moses is carrying the tables of stone, Solomon a temple, and so on. On the south side are the New Testament saints, they, too, holding their emblems, this being the picture that completed the decoration in the chancel. On the south side of the inner sanctuary is a very large representation of the Worship of the Magi, and on the north side is the Annunciation of Our Lady. On the other side of the choir is a large picture of an angel with a scroll on which are the words, "Laudate cum omnes angeli ejus"—"Praise Him all ye angels." At the base of the screen are the twelve Apostles, six on either side, each holding his emblem, and it yet remains for some one to fill in the four panels of the gate with the four Doctors of the Church, St. Jerome, St. Chrysostom, St. Augustine, and St. Ambrose. The various niches in the choir where there is no room for a design, notably at the organ side, have been filled in with alabaster.

The decorations in the Lady-chapel, in which are held the daily services, are worthy of a passing notice. The east window is filled with "The Presentation in the Temple," and in each of the other windows is a figure of a virgin saint, the four depicted being St. Ethelreda, St. Agnes, St. Catharine, and St. Cecilia. The panels in the altar are filled with "Our Lord," "The Blessed Virgin," and "St. Joseph." This completes the whole of the paintings in the church at present, including the reredos, the inner sanctuary, the choir screen, Lady-chapel, and the nave.

The glass is by Messrs. Lavers & Westlake. Over the chancel arch there is a large mosaic representing the Second Coming of Our Lord.

The whole work has been carried out under the superintendence of the architect, Mr. James Brooks. The paintings and the design of the mosaic are all from my own studio, and the work has been spread over many years.

N. H. J. W.

MOSAICS, MURANO AND TORCELLO.

OF these mosaics, the two upper figures are in the floor of the Duomo at Murano, and date about the beginning of the twelfth century. The inlay in the other sketch is in the floor of the Duomo at Torcello, and dates about the early part of the thirteenth century. They were measured, drawn to scale, and coloured on the spot by Mr. Arthur C. Blomfield, to whom we are indebted for the loan of his drawing.

The following are the memoranda as to colour on the original drawings, but which are not legible on the lithograph:—

"*Murano.*—All green but the two top ones, which are red (Indian). Black and white border round tail. Tail has black ground. Background white The wings of griffin green.

Torcello.—All borders and broad pieces grey. Colours in mosaic black, dark green, yellow, greyish white, yellowish white, light indigo, Indian red, and mottled."

The drawings, in two separate frames, were hung in the Architectural Room at this year's Royal Academy Exhibition.

THE LAUNDRY AND DOMESTIC APPLIANCES EXHIBITION.

THIS Exhibition was formally opened on August 25, at the Central Hall, Holborn, but it was in the usual state of incompleteness that one quite expects on opening days, and there was little to be seen. It is odd that exhibitors will not have their stands ready for the opening day; there is no rational reason for it, and it is as vexatious to the promoters of the undertaking as to any one, and the only known cause is carelessness and unbusinesslike ways on the part of those exhibiting. In the case of this display at Holborn, the "unfitness" is as bad as it can be, and it is very possible our notice may not include some of the most interesting things on that account. There was evidently going to be a large and expensively-fitted stand against the east wall by the entrance, but at the time of our visit it consisted of about six courses of white glazed bricks, and nothing more. Several good firms are fitting up large appliances and novel laundry machinery, but the stands on the opening day were in a state of chaos. The management were in scarcely a better state, as it was impossible to get a catalogue (they had not arrived), and up till about 3.30 p.m. the stalls had not been numbered.

The general idea of the Exhibition is good, but there is very little of it. It is confined to the ground floor, the gallery being empty, but some amends exist in the fact that the wretched "novelty" stall is noticeably absent. What there is of the show is of a genuine character, and there is as much to interest those actually seeking information of the kind in this Exhibition as we get in collections on a larger scale.

It is difficult to account for Messrs. Bradford & Co.'s absence from this Exhibition.

Messrs. Hindley, the well-known firm of engineers, furnish the steam power for the machinery in motion, which is ranged along the west wall. They show one of their recognised type of vertical boilers with engine. It is doubtful if they are attempting to exhibit more than their name, as the boiler itself is an old friend of many previous Exhibitions, but it is doing its work in a satisfactory way. Occasionally the engine or the boiler enters into competition with the music, but the engineers do not permit this to last long.

The Blackman Company, makers of the Blackman Air Propeller or Extractor, have an exhibit of their new system of drying in laundries. They have their apparatus erected in its full size, and at work, and standing ready to raise the temperature of 20,000 ft. of air per minute from 60 deg. to 140 deg. The apparatus itself consists of a sheet-iron structure, slightly resembling a large multitubular boiler, mounted upon a brick base, which contains the furnace. Instead, however, of water taking part in the process, the heated products from the fire are directed and caused to circulate amongst these tubes externally, and the tubes themselves are used to heat the swift current of air passing through them, induced by one of the firm's propellers. They claim that the construction is such that no parts of the heating surfaces get over-heated, and damp clothes can be dried perfectly in great quantity in eight minutes. Whatever system of drying may be adopted, there is much sense and gain in the warmed air being in fairly swift motion, for much of the success in drying depends upon the rapidity with which the air, when moistened, is removed.

Messrs. Glover & Hobson, of Albert Ironworks, Old Kent-road, display two or three of their "Excelsior" ironing machines. These have the customary polished and gas-heated cylinder, travelling over a padded sliding table. This firm, has, however, introduced various minor improvements, rendering the machines very perfect, and the stand is worth visiting. The machines are shown in use, amongst the machinery in motion.

Messrs. Chas. Wilson & Sons, of Leeds, have a stand immediately opposite the entrance, and are showing all their different kinds of gas-stoves. Their chief novelties at present are a nursery stove and a stove suited for the bars of public-houses. The former has a good appearance, and the firm's name is sufficient guarantee of effectiveness. It has convenience for food-warming on top, and the heated part below is guarded by a pair of trellis gates, which are ingeniously fitted to prevent their being opened by children. The peculiarity of the bar-stove is a duplex tap arrangement, by which it can be used in winter for heat radiation and water heating as well, but when the weather is mild it can be used for water heating alone. It has a water-container fitted within it, provided with a tap. This stove is also fitted with gate-guards to prevent ignition of dresses, &c. This firm shows a portable washing-copper, heated by gas. If appearances in coppers go for anything, this leaves nothing to be desired.

Messrs. Clement Jeakes & Co., of Bloomsbury, domestic engineers, show a large washing machine capable of dealing with about 200 pieces at once and cleansing them in very little longer time than it takes to explain. Nothing more can be said of this than it is a large-sized machine of the ordinary revolving type, but of excellent finish, and bearing evidence of great durability and good workmanship. This will be found amongst the machinery in motion.

Messrs. Doulton & Co. are going to considerable trouble in fitting up a water-softening apparatus. This is well worth a visit from those who are interested, as they make no secret of the principle, being similar to the now famous Clark's process, but they have it all fitted up in a compact manner, and convenient for inspection.

The Carboid Oil-less Bearing Company, Limited, introduce their patented bearings. They make these adapted for every purpose, and practically guarantee that they will last about the same period that brass bearings will; but, whereas the latter require lubrication and the attendant care, their bearings are fitted, and after a day or two's inspection, to see that all is going well, they are left to themselves. Two years without care or attention, and, of course, without lubrication, is considered ordinary wear for these bearings. The articles themselves, which are made in various forms, much resemble compressed blocks of graphite (black lead). Doubtless this material enters largely into the composition, for everyone knows what an excellent thing it is for reducing friction between surfaces. The shafting on the machinery-in-motion side of the hall is fitted with these bearings, and it is anticipated that for the short period of this Exhibition they will scarcely show any signs of wear at all. Certainly the shafting seemed to work very smoothly and well at the time of our visit, and there seems some value in the invention,—time will show, of course. It would certainly be an advantage if oils, with the attendant dirt, could be disposed of, and there would be a decided gain in adapting these to rolls which, for purposes of manufacture, have to be heated to high temperatures. The same gain would be effected if these bearings could be applied to pulleys or rollers that have necessarily to be in moisture and dirt; cable tram pulleys, for instance.

An appliance for domestic use and well worth notice is the "Regina" washing machine exhibited by L. Frost & Co., of Finsbury-pavement, and situated in the centre of the hall. This appliance is intended to supersede the more ordinary kind of domestic washing machine, which is a rotating barrel arrangement. The plan of this washer is the raising and lowering, with partial revolution, of an instrument much resembling a "dolly," in a fixed chamber lined with corrugated zinc. The motion of the handle which brings about the result is simplicity and ease itself, and it has every appearance of being a successful device. the cost is much below an ordinary washer.

This about completes the list of interesting novelties, not a great number, but what is lacking in quantity is well represented in quality. There are, of course, many other things to be seen, and very nearly everything that comes within the category of domestic appliances is exhibited. There are, in addition, several firms showing the various substances used in laundry work, soaps, starches, blueing materials, &c., &c. The Exhibition closes to-day (September 3).

REMOVAL OF H.M.S. "FROLIC."—Thirty years ago, before the making of the Victoria Embankment, the Thames police ship, a brig, lay moored close in shore, opposite the river front of King's College. On her removal for the new river frontage the police were assigned a floating pier just below Waterloo Bridge. The brig's place was then taken by the *Rainbow*, for the Royal Naval Artillery Volunteers; that, again, was supplanted in May, 1888, by the *Frolic* gunboat, 4,610 tons. The Naval Brigade being now disbanded, the Admiralty have ordered the *Frolic* to be towed to Sheerness for refit as a coastguard watch-ship on the river Crouch, near Burnham, in Essex.]

THE PORTSMOUTH SEWAGE OUTFALL WORKS.

THESE works formed the subject of the following paper Sir Frederick Bramwell, F.R.S., read at the recent Portsmouth meeting of the Institution of Mechanical Engineers :—

There is so little of novelty, or of matter calling for attention, in the Portsmouth sewage outfall works, that the author feels bound to apologise to the Institution for presenting a paper upon them. He offers, however, these three facts in excuse:—the first, that the works are in the town where the Institution is holding its Summer Meeting, and can therefore be readily visited; the second, that they were carried out by one of your Past-Presidents; and the third, that the system depends entirely upon the employment of steam-engines and pumps, and is, therefore, essentially one of mechanical engineering. This paper does not pretend to deal with the sewerage system of the district generally, with the original designing and laying out of which the writer had nothing to do. He found that system in existence; and, except that, prior to the commencement of the outfall works, there was undertaken the task of clearing out accumulations of sludge from the sewers, and that during the execution of the outfall works some portions of the system were renewed with better materials and rearranged so as to give better falls, he wishes it to be understood that the title of the paper practically expresses the limit of the work for which he is responsible.

District.—The district to be sewered being of considerable extent, and as a rule flat and low-lying,—indeed but slightly above the sea-level,—those who had laid out the works of sewerage had found it impossible to obtain, or even to approximate to, a proper inclination of the sewers, without causing their point of delivery into the sea to be at some depth below ordinary high-water; and therefore the original outfall plan, which was in operation immediately preceding the time when the writer undertook the work, was one that involved the pumping of some portion of the sewage.

Sewerage System and Pumping Arrangements—The system of sewers and the arrangements for pumping were generally as follows. For Portsmouth and for the outlying neighbourhood there were, and still are, four main arterial lines of sewers; two of the lines are at a high level, and two at a low level, each line passing through a different portion of the district, and each being provided with its tributary sewers, drains, and house connexions. These four lines converged towards the Henderson-road at Eastney, and were there brought into two main lines, one high-level and one low-level, which delivered into sumps at the pumping-station, situated at the eastern end of the Henderson-road. From these sumps the sewage was lifted by engines, constructed by Clayton of Preston, into an outfall brick sewer, which, proceeding from the pumping-station, terminated on the sea-shore at Fort Cumberland, and was continued by two cast-iron pipes of 3 ft. bore, extending about a quarter of a mile into the sea.

Outfall.—It need hardly be said that commonly the greatest difficulty,—in fact, *the* difficulty, in town drainage is to find an outfall which will admit of the delivery of the sewage without setting up a nuisance; a nuisance which either may be one recoiling upon those who have delivered the sewage, or may be, and not infrequently is, one that is inflicted upon another locality. In the case of seaside towns, such as Portsmouth, the simplest and the most ready way of dealing with sewage, when collected, is to deliver it into the sea, choosing, if possible, some point where its delivery will not be a nuisance, and also, if possible, some point where it can be caused to flow into a tidal or other current, which will with certainty carry it away from the neighbouring shores. In this particular respect Portsmouth is well placed, for there is situated about a mile to the east of Southsea the large natural reservoir or body of tidal water called Langstone Harbour. The main channel to this harbour from the open sea passes near Fort Cumberland, and is there only some four hundred yards wide; and as the greater portion of the water of Langstone Harbour flows in and out through this channel at each tide, the maximum current at spring tides has a velocity of sometimes as much as five to six miles an hour. It is obvious that, in order to obtain the advantages afforded by the proximity of Langstone Harbour to Portsmouth, the delivery of sewage should never be made during a flood tide, as that would simply mean carrying the matter into the harbour, to be there deposited and to accumulate. It is further obvious that the delivery should be confined to so much of the ebb tide as will cause the sewage to be carried to such a distance that it shall not return during the later portion of the flood, and thus shall not reach the harbour or the adjacent foreshores. In the scheme of outfall which preceded the works carried out by the writer, the intention was that the pumping engines should go to work at about one hour after high water, continuing for the whole of the early portion of the ebb; in fact, until the tide had fallen so low that the outfall sewer would deliver naturally. This arrangement, however, was attended by the difficulty of the cessation of the delivery of sewage during a considerable portion of the flood tide. And further,—the production of sewage being continuous, although not uniform, while the period of delivery must vary in its time from day to day according to the tide,—it followed that every fortnight there occurred times when the hours of greatest production of sewage were the very hours during which the sewers could not deliver naturally, and when also the pumps should not work. At such times the sewage had to accumulate in the sewers. The accumulation beginning from the immediate neighbourhood of the pumps, and extending backwards up the sewers to such distance inland as sufficed to contain it. It need hardly be said that this was a system where, owing to the cessation of all current in the sewers, subsidence of the more solid portions of the sewage readily took place; and a great part of this subsidence was not cleared out by the renewal of the current in the sewers when pumping was recommenced. Under these circumstances it was not surprising to find that, in the effort to make a compromise between the conflicting difficulties, the outflow was continued not only during the whole of the later portion of the ebb tide, but frequently also for some portion of the flood tide; and that, notwithstanding this improper extension of the pumping time, serious accumulations of material took place in the sewers.

Tidal Experiments.—Before proceeding to develope an outfall system which should overcome these difficulties, the writer thought it necessary to obtain practical and trustworthy information as to the behaviour of the currents after they had flowed out from Langstone Harbour, under all the changes of tides from springs to neaps, and, as far as possible, under the variations due to the direction and force of the wind. During the winter and spring of 1883-4 a long series of experiments were carried out in all sorts of weather, and in all states of the tide, by means of the usual vertical float, made of a piece of scaffold-pole, 6 in. diameter and 5 ft. long, and weighted at its lower end, so that in still salt water about 4 in. only of the upper part was above the surface. The floats were, in all cases, put into the sea as nearly as possible at the intended point of delivery of the sewage, and were followed by a boat, in which were the observers, who at regular intervals took the bearings of certain fixed points on the shore, by means of an azimuth compass, or of a theodolite. In all, something like thirty experiments were made. The records were afterwards plotted. It was found that, whether the tides were springs or neaps, and whatever might be the direction of the wind, the floats, immersed shortly after high water, were carried out to sea, and had no tendency to re-approach the shore. These experiments confirmed the anticipation and hope entertained, namely, that, if the delivery of the sewage could be confined to a brief period, beginning shortly after the commencement of the ebb tide, it would be possible to fulfil the condition of getting rid, once and for all, of the sewage matter of Portsmouth, without the production of nuisance either to Portsmouth itself or to any other locality. With respect to the other part of the problem,—that of preserving a continuous flow in the sewers,—the solution clearly was to keep the pumping power constantly at work, and to provide it of such capacity that it should be able to deal with the maximum amount of sewage (not only for the present time but for fifteen years to come), and also with that portion of the rain water which would inevitably find its way into the sewers along with the house sewage, the ordinary rainfall being partly disposed of by a separate system.

Storage Tank.—These two conditions,—of the pumping power being continuously at work, and of the delivery of the sewage being restricted to two brief periods in the twenty-four hours, namely, shortly after each high water,—involved the provision of a storage-tank of sufficient capacity to contain all that was pumped during the time the outfall was closed; in fact, the maximum sewage then being brought to the existing pumping-engines, and the sewage of Stamshaw, an outlying part of the borough to the north, and of the Government establishments, dockyard, barracks, &c., not at that time connected with the system; and also a certain portion of the rain-water. Further, an estimate was made, based on the increase of the population in the previous decennial period 1871-81, of the probable population to be dealt with at the end of the next fifteen years. Bearing these circumstances in mind, it was determined to give the tank an aggregate capacity of 4½ million gallons. Having regard to the necessity for very rapid discharge from the tank into the sea, a discharge in fact restricted to an hour, it was obviously desirable that the site of the tank should be as near to the point of delivery as possible, so as to keep down the length of the very large outlet channels required. Fortunately the Corporation of Portsmouth, by agreement with the military authorities, were permitted to make use of the glacis of Fort Cumberland for the site of the tank; and were thereby enabled to construct it on the very margin of the channel from Langstone Harbour. As it was necessary to keep the upper surface of the tank at such a level that its cover, forming once more the glacis of the fort, should not be raised so as to interfere with the line of fire, and as it was also necessary that the floor of the tank should be but little below ordinary high water, in order to enable it to be entirely emptied when the tide had fallen but a small distance, the depth of the tank had to be limited to 11 ft. 6 in., thus involving an area (including the outer walls) of some 1¾ to 2 acres. The tank is divided in plan into three compartments, which are distinct and are practically equal in area. Any one of these can, if necessary, be thrown out of use for repair; and advantage has been taken of this division to enable any compartment, by means of the cross culvert at the sea end, to be flushed for cleansing purposes, by passing through it to the sea the contents of either or both of the other compartments. Further, although the tank is filled by pumping, and not by gravitation, and therefore there should not be pumped into it any sewage in excess of its capacity, yet each compartment of the tank is provided with an overflow direct into the outlet culvert.

Ventilation.—As the tank occupies the glacis of Fort Cumberland, the military authorities, as one of the conditions upon which the use of the land was granted, insisted upon some artificial mode of ventilation being provided, because fears were entertained by them that possible nuisance might be caused to the garrison of the fort. Advantage was taken of the overflow and outlet culvert to ventilate the tank by connecting it through a flue to a chimney having its outlet at a height of 90 ft. above the ground level, the inlets for fresh air being through the roof of the tank, each provided with a self-acting flap-valve, hung so as to open only inwards, and placed at the sea end of the tank, the part most remote from the fort. A furnace is provided at the base of the chimney; and all the air supply for this furnace is, as a rule, drawn from the tank, and so through the fire, thus providing for the combustion of deleterious gases.

Construction.—The tank was constructed with Portland cement concrete walls, with an internal brick facing set in cement, and with a vertical water-tight collar-joint, also in cement, between the concrete and the brick lining. On the brickwork of the lining walls, in which at intervals brick piers or pilasters are built, and on cruciform brick piers founded on the concrete bottom of the tank, the brick arches forming the roof are carried; the haunches of these arches are filled in with rough concrete, laid with a fall towards small drains which are carried on the concrete in the centres between the arches. On the completion of the arched roof the shingle and the mould were replaced, and the surface was sown with grass and clover-seed. The tank roof had to be of sufficient strength to carry field artillery, which in any military operations might possibly have to traverse it. Experiments were made to find the minimum number of half-brick rings neces-

sary to support, with arches of this character, the required weights. As a result of the tidal experiments, it was found desirable to provide for the whole of the sewage being discharged in a period of one hour, this period commencing from an hour to an hour and a half after high water. That is to say, with the very slight head provided by the tank, the whole of its contents, namely 4½ million gallons, had to be got rid of in sixty minutes. The outlet culvert, which extends crossways of the tank at the end farthest away from the sea, was therefore made as large as 6 ft. 6 in. by 5 ft., or roughly more than 30 square ft. in area. This culvert delivers into a small chamber from which three cast-iron outlet pipes, each 3 ft. 6 in. diameter of bore, were laid across the foreshore to below low-water mark.

Discharge Valves.—In order to avoid the necessity of employing very large valves, needing several men to work them, it was found imperative to provide each of the compartments of the tank with as many as three valves; so that, to deal with all the compartments, nine valves had to be worked. As the maximum time during which discharge should take place was one hour, it was obvious that only a few minutes could be afforded for the opening of these valves; for, allowing only the very modest time of five minutes for the opening of one valve, the whole of the nine would have required three-quarters of an hour; or, having regard to the shifting from valve to valve, more probably an hour; so that the last valve would not have been opened until the whole time at disposal for the emptying had elapsed.

Turbines.—After the first of these nine valves had been finished and tried at the factory, it became evident that some kind of motive power would be necessary for opening them. Many suggestions were made and considered. Finally a plan was proposed by Mr. Harris, now the writer's partner, which solved the whole difficulty. The principle upon which Mr. Harris's plan is based is that of making the sewage itself open the outlet valves. This is effected by gearing up each of the main valves to a small turbine. Each turbine is provided with a sluice 6 in. square, having a spindle, carried up above the roof of the tank, finishing in a hand wheel. All that the tank attendant has to do, when outlet time arrives, is to open in succession these nine turbine sluices. As soon as the turbine is in motion, the continuance of the revolution of the sluice spindle, by means of a screw upon it, puts an Addyman clutch into gear with the spindle of the main valve; and the turbine continuing to work rotates through wheel-gearing the spindle of the main valve, thereby lifting the valve. As the valve rises, it carries up with it a horizontal projecting plate, which, on reaching the top, closes the outlet from the bottom of the turbine, thus causing the turbine to cease work, and bringing it and the main valve quietly to rest. The result of this arrangement is that one man is able to open the whole of the nine valves in succession in something less than ten minutes, each of the valves being 4 ft. by 3 ft. 6 in., equal to an area of about 14 square feet. Some doubts were expressed as to whether this plan, which seems complicated in description, would work satisfactorily, having regard to the fact that sewage was the operating liquid for the turbines; but the writer is glad to be able to say that from the time of opening the works until now no trouble at all has been experienced. Each turbine is surrounded by a galvanised iron screen, so as to prevent large "flotsam and jetsam" from interfering with the working of the gear. By means of these nine main valves, the outlet culvert, and the pipes, it is possible to empty the whole of the compartments of their contents in something like fifty minutes, or in less time than that shown by the tidal experiments to be necessary; and to do this at no greater cost than the wages of one attendant. For shutting down the valves there is ample time after the sewage has been discharged; the attendant readily closes them, which is a fairly easy operation, as their weight assists him.

Electrical Indicator.—The authorities desired to have the means of assuring themselves from day to day as to the time of tide when the discharge from the different compartments of the tank was commenced: and also as to the duration of the discharge. With the object of affording this information to them, and also to the men in charge of the pumping engines, an electrical indicator was fixed in the engine-house, which, combined with clockwork, shows at every 6 in. depth the rate at which the tank is being filled, and then shows the time at which the discharge is commenced, and the duration of that discharge.

Outlet Pipes.—The fixing of the three cast-iron pipes, laid across the fore-shore for the discharge of the sewage, was a work of great difficulty, and of some danger, owing to the swiftness of the tidal current, and to the exposed nature of the shore at this point. The mode adopted for securing the pipes is an extremely substantial one, consisting of a series of rows of screwed piles, carrying cross iron supports. The ends of the pipes are protected by a dolphin, constructed of strong wooden piles driven into the foreshore, and surmounted by a beacon, which is used for the purposes of navigation of the entrance channel. Prior to the erection of this dolphin, some fears had been expressed, based upon what had happened to previous dolphins at this place, as to the possibility of any structure being erected capable of withstanding the severe effects of winter storms; but the writer is glad to say that the six years which have elapsed since the dolphin was erected have passed without damage to it of any kind.

Groynes.—The banks of the channel being exposed to very heavy weather, and to the scour produced by the rapid flow of the tide, observation was made as to the effect upon the foreshore in times past; and it was found that in the neighbourhood there had been very considerable movements of shingle, sometimes by way of accretion, but also sometimes by way of removal, involving the destruction of a certain sea-wall work that had been carried out there. It was therefore necessary to resort to the use of groynes. These were simply constructed, consisting merely of rows of rough piles and planks: the piles in each row being about 6 ft. apart, while the row is placed at such an angle to the shore as was deemed most advisable. To these piles rough 3-in. deals were spiked, only one row in height being fixed at a time, and this was left until the shingle had collected behind it, when another row was added, and so on; and in this way thousands of tons of shingle have been collected at the back of the groynes to protect the works. It may be mentioned that the collection of shingle is an operation which cannot be hurried, and that any attempt to complete a groyne to the full height at once, on this coast at all events, frustrates the object; it must be done little by little.

Main from Pumping Station.—The height at which the storage tank was placed involved the connexion to it from the pumping station being under pressure; and this connexion was therefore made by a cast-iron pipe 3 ft. 6 in. diameter, laid to follow practically the surface-line of the ground through which it passed, and provided at the high parts with automatic air-outlet valves. This main is commanded by a stand-pipe in the engine-house premises. It is practically parallel with the old brick outfall sewer for the first 500 yards of its length; it then bends away to the north-east, passes round the moat of Fort Cumberland, and, approaching the tank at the north-west corner, is carried along its west wall, and is connected to the tank by three branches, 2 ft. 6 in. diameter, one in each compartment, each connexion being governed by a screw-down sluice-valve.

Pumping Engines.—The new pumping engines consist of two similar compound-cylinder beam-engines, manufactured by Messrs. James Watt & Co., of Soho, each competent to exert 150 indicated horse-power, with a boiler pressure of 80 lbs. on the square inch. The sewage pumps are arranged to receive the sewage from both the high and the low-level sewers, thus taking advantage of a portion of the sewage being delivered to the pumps at a higher level. The boilers are Lancashire boilers, also constructed by Messrs. James Watt & Co. The two separate Clayton engines, which had done all the work for the twenty years prior to 1887, have, since the new engines were put to work, been changed into a compound pair. Ordinarily one of the new engines in conjunction with the pair of old engines, or the two new engines by themselves, will suffice for the maximum work; thus giving a 50 per cent. stand-by of engine power, which can be employed when needed. The boilers of the old engines have also been thoroughly overhauled, repaired, and renewed where necessary. They have been connected to the new boilers, and the steam and other piping have been so arranged that either engine, or pair of engines, can obtain its steam from any or from all the boilers. One of the engines at least is kept at work night and day, from year's end to year's end, thus continuously extracting the sewage from the sewers, and getting rid of the necessity of allowing it to back up in the town sewers, as it had previously done for hours together. The leading dimensions of the new engines are as follows:—

	Diameter. in.	Stroke. ft. in.
High-pressure cylinder	20	4 2
Low-pressure cylinder	30	6 0
Sewage Pumps, two in number to each engine and double acting ..	30	3 3

According to the contract, the working speed of each engine was not to exceed twenty-four revolutions per minute; and at this speed, and with steam in the boilers at only 50 lbs. pressure per square inch above atmosphere, and when cutting off at half stroke in the high-pressure cylinder, each engine was to develope not less than 125 gross indicated horse-power. Each of the four sewage pumps is of sufficient capacity and strength to lift 250,000 gallons of sewage per hour, against a total head of 40 ft. In order that they should lift this quantity, even when they are somewhat worn, they were to be of such dimensions that, if there were no waste or leakage past the piston or valves at all, each pump should lift 7½ per cent. more, or 268,750 gallons per hour. There are four Lancashire boilers, each 27 ft. 1 in. long by 7 ft. diameter, and each having two fire-flues 2 ft. 8 in. diameter. Their working pressure is 60 lbs. per square inch above atmosphere.

Reconstruction of Sewers.—In addition to the outfall works, the sewers of the district generally were overhauled and repaired; and such modifications as were consistent with the system were made, with the object of increasing the rapidity of flow of the sewage, and of preventing flooding in times of heavy rain. A portion of the district of Southsea is upon bog land; there is no doubt that it was originally covered by the sea,—in fact, that a large portion of Southsea is merely reclaimed land. Many houses have had to be abandoned and left uninhabited, owing to settlement. The sewers which existed in the streets in this area were found on examination to be broken-backed and out of level, and altogether in an extremely unsatisfactory state. It was felt that some means should be adopted for preventing, as far as the sewers were concerned, a recurrence of these evils; and rods were driven down through the peat, and it was found that, at depths varying from 10 ft. to 25 ft. below the road surface, there was solid gravel or shingle. A trench was sunk to the level of the intended underside of the concrete upon which the sewers were to be carried; and wooden piles were driven down in this trench until they were well into the gravel. The heads of the piles were cut off level with the bottom of the trench, and rolled iron joists were bedded upon them, thus bridging the distances from pile to pile. Upon the joists poling boards were laid transversely; and upon these poling boards was placed the concrete, upon which the sewers were bedded. The sewer was then put in upon the concrete, the trench filled in, and the road surface made good. This construction was no doubt somewhat expensive, but time has proved that the expense was fully justified. The sewers, on a recent examination, were found to be perfect in line and joint throughout, and this mode of construction has since been adopted for other portions of the town, where similar difficulties had to be contended with.

The whole of the new works were carried out without disturbance of those already in existence; and these with the system of sewage discharge in use prior to 1887 were maintained until the present outfall works were put into operation. They were completed in 1887, Alderman Sir William King, the then Mayor, presiding over the opening ceremony, which took place on May 9 in that year.

SURVEYORSHIP, BERMONDSEY.—Mr. Frank Sumner, from the office of the Willesden Local Board, has recently been elected Surveyor to the Vestry of Bermondsey, to fill the vacancy caused by the resignation of Mr. Geo. Elkington.

COMPETITIONS.

NORTHAMPTON INSTITUTE, CLERKENWELL.—This is a building, to be erected under the auspices of the governing body of the City Polytechnic, on a site given by the Marquess of Northampton, for which six architects are to be invited to submit designs, who will be paid a fee of 40*l.* each. The names of the six competitors are not yet finally settled. The conditions of competition have been drawn up by Mr. Chas. Barry, who will act as professional assessor. The designs are to be sent in on December 1 of this year.

MANCHESTER NEW TECHNICAL SCHOOL.—In connexion with the competition for the erection of the above building, the Technical Instruction Committee of the Manchester Corporation report that in response to their advertisement they received in competition twenty-six sets of designs. It was deemed advisable to obtain the assistance of Mr. Alfred Waterhouse, R.A., as assessor. The designs were hung for inspection in a large room in the School of Art, where Mr. Waterhouse began his labours on August 22. At the end of last week the committee inspected the plans, in company with their adviser. After much deliberation the designs which were considered to be entitled to first, second, third, and fourth premiums respectively were selected. The sealed envelope containing the name of the successful competitor will not be opened until the confirmation of the committee's proceedings by the Council.

Correspondence.

To the Editor of THE BUILDER.

THE INSTITUTE AND ARCHITECTURE.

SIR,—In the history of institutions as with individuals there would seem to come a time of crisis, which, if taken advantage of, may issue in increased vitality.

To such a critical period the R.I.B.A. has arrived. It has done good work in the past by opposing abuses,—raising the character of the architect and of the surveyor,—encouraging students by offering good prizes for competition, &c., and in founding a library of great value and importance.

This is a work which could only have been accomplished by men of a certain stamp and energy. They probably made a mistake when they called it an Institute of "Architects," for it would more correctly be defined as an Institute of Architects and of Surveyors, &c. As it is, the proportion of architects to surveyors is small; and when the former exhibit any anxiety that architecture should be adequately represented, they are repressed, and dubbed by that most objectionable title, "Art-Architect."

Architecture as a "fine art" is, perhaps, little understood, and is very generally regarded as something to be applied to a building; whereas architecture deals with, and stamps with its impress, all the process of building, beginning with plan, elevation, and section, which are of equal value in the development of architectural character, and ending with the right treatment of the several materials employed in the construction of the building.

An iron girder, for instance, treated architecturally, should differ from the mere product of the engineer's method. And in the use of marble, stone, or wood, there is a treatment for each which should express the character of the material, and the forms suitable for one material should not be used interchangeably with another. To give a definition of all that goes to produce "architecture" is difficult. It is obvious that all building is not architecture, neither is building *plus* ornament, or decorative features, architecture. Architecture does not deal with exceptional kinds of building, but deals with ordinary building in an exceptional way. Again, the difference between building and architecture is not primarily a question of form, though form has much to do with it, as that which applies to the outward thing, but architecture possesses also an inward quality, expression, and character, which engenders in the beholder emotion which responds to the sense of fitness.

The subtle and living attributes are recognised by the artist, and run through the whole gamut of art, and it is these qualities which alike distinguish real sculpture and painting from mere imitations and lifeless work.

In the memorable case of "Belt *v.* Lawes," the judge, jury, and the majority of the public, failed to see that the mere appearance of the likeness of a thing did not constitute the art of sculpture, or raise the work above that which a cast of the object could represent even more accurately; and the Royal Academicians were quite unable to put into language, which the legal mind could compass, any definition of the distinguishing characteristics of real and fictitious art. A good work of art is known and recognised as such at all periods, though it may not be publicly acknowledged until years of neglect have passed over it, until, in fact, the opinions of those who have eyes to see, and capacity to judge, have accumulated with sufficient force and weight to mark it as something to be admired. The theory that good work is affected by fashions and taste is a mistaken one, yet it is quite true that with the ignorant the prevailing fashion may form the standard of acceptance or rejection.

An architect must be an artist, or he has no right to the title. A man may be a good builder, a surveyor, an estate-agent, or sanitary engineer, but Art is so jealous a mistress that it is very unlikely he will be an architect also.

At the present time the Institute has an opportunity to put itself in the right with regard to these matters, for it has under consideration the qualification of its "Fellows."

Surely the qualification for Fellowship should not be the quantity, but the quality of the actual work done by the candidate. Nothing else can make the title of "Fellow" worth anything.

It is admitted that there can be no examination in art, and architecture is an art. You can have the science without art, but you cannot have the art without the science, and where one begins or the other ends it is impossible to say. No amount of examination can make a man an architect. Examination of students is well and good, but here again the Institute might with advantage cease to use the title "Examination in *Architecture*," as being incongruous. It is true that an artist, if he is to exercise his art aright, should be taught building construction, the strength of materials, the capacities and limitations of the several materials at his command; also sanitation, and the practice and methods employed by the several crafts in connexion with his work as an architect, and in all of these things the student can be examined.

It is not that the present Institute Examinations in any way intend to undervalue or underestimate the importance of what is called the "art side," but it is this very division of art and science in architecture which is injurious and misleading, especially when it is entitled an "Examination in *Architecture*" which comprises both. If this title were altered it would meet the objections which, with justice, are raised against these Institute Examinations, and go far towards healing the present breach; and if the title of "Fellow" can be made a distinction and not a superior qualification to practice, a still further division may be prevented, for there can be no doubt that,—

"There is a rift within the lute
Which by and by will make the music mute."

JOHN BELCHER.

20, *Hanover-square, W.*

LONDON WATER SUPPLY.

SIR,—Referring to your "Note" in connexion with a double supply, and Mr. Richardson's letter to the *Times*, while agreeing with you in the opinion that there would be many difficulties in the way of two distinct supplies to every house, I think it would be quite practicable to reserve a supply of pure water (when obtained) for domestic and other purposes for which it is indispensable, and using a supply obtained from the Thames and Lea for those purposes not requiring water of a high standard of purity,—such as street watering, fire extinction, flushing of sewers, and the washing of carriages, stables, yards, &c.

This latter supply could be pumped into mains direct without any filtration.

The provision of a duplicate system of mains would not appear to be such a very costly undertaking, as many of the thoroughfares are at present supplied with double mains.

Were this system adopted, a much less voluminous supply of pure water would be sufficient for the needs of London.

It would not do, however, to take this impure supply into private houses, as, apart from all other considerations, it would be very liable to be used for drinking and cooking purposes, owing to carelessness or a temporary cessation of the purer supply, and much danger would therefore arise.

I may say I wrote with this suggestion to the *Times* a day before Mr. Richardson's letter appeared, but I suppose a non-technical editor could not discriminate between my suggestion and the other,—although materially different,—and so considered its publication unnecessary.

HARRY G. ASSITER.

LATER SCOTCH CASTLES.

SIR,—I observe in your appreciative article (for which I am indebted) on the above (*Builder*, August 6) that you state that the part of the book relating to town houses and churches seems rather like padding, and is out of keeping with the rest of the work.

But I hope you will allow me to remind you that the book professes to treat of the domestic architecture of Scotland as well as the castellated, and it appears to me that without some notice of the town houses it would have been not only incomplete, but would have left out a very important chapter of the subject. With regard to the churches, the towers of certain of them were practically castles, and were used as such, and the resemblance of them all in their style to the castellated and domestic architecof the country was, I think, well worth pointing out in a book of this nature, and to be quite within the scope of the undertaking.

With regard to the Scotch sun-dials and their amount of practical use as compared with English ones, I grant them to be entirely useless adjuncts to a railway station; but in a garden where one has leisure, it is rather interesting to watch the shadows moving about the complicated surfaces of such a sun-dial; these all telling the same story in a silent manner seems to be quite in keeping with the ideas of such a place, and at the same time furnishing the mind with a little *gentle* curiosity.

Where can one see illustrations of those beautiful English sun-dials to which your article refers so enthusiastically? I have long wished to be able to compare the sun-dials of Scotland with those of other countries, but have not been able to see any collection of plates to enable this to be done.

Edinburgh, Aug. 26, 1892. THOMAS ROSS.

*** The point of our comment was that, whereas Scotch castellated architecture was treated as far as possible completely and exhaustively, domestic and city architecture were only treated briefly and incompletely, producing a book complete on one side and incomplete on the other, which was to be regretted; and that the book would have been still more satisfactory if it had been confined to a complete treatment of one class of buildings. In regard to sun-dials, we are not aware that there is any complete illustrative work on English sun-dials: it would be quite worth doing. We admit the "gentle curiosity" stimulated by the favourite Scotch form of sun-dial; our complaint is that they are, in a decorative sense, unpleasing and ungraceful objects, while the English sun-dial is nearly always graceful. —ED.

"THE BUILDER AND THE ARCHITECT."

SIR,—Do not be too hard on Mr. *Punch*. I have known and loved "The Walrus and the Carpenter" since its publication some twenty years ago; and I think the verses in last week's *Punch* are worthy of preservation as a successful parody. Surely it is true that architects do act for, or with, builders in the covering of estates, though not, one hopes, with the dreadful consequences described. There is generally some exaggeration in satire, and, personally, I am charmed with the poem, which I mean to keep as a warning to the office.

R. LANGTON COLE.

*** We admit the literary merit of the parody, but our opinion as to the justice of the satire is unaltered. Architects do not act with or for *that* kind of builder.

The Student's Column.

CONCRETE.—X.

ARTIFICIAL CEMENTS (*continued*).

PORTLAND: SAND TEST.

ALTHOUGH the testing of cement neat is undoubtedly important, it does not really give us an exact idea of the working value of the cement; for cement is scarcely ever used neat, but almost invariably in combination with sand and other substances. This is one strong argument in favour of testing briquettes composed of cement and sand, so that the test may bear a closer relation to the uses to which the cement must be put in actual construction. Another argument, even more forcible, is that the strength of neat cement does not bear a fixed ratio to the strength of the cement when mixed with sand, and many figures might be quoted to show that, of two cements, one gives better results when tested neat, while the other is the stronger when tested with sand. The German and Austrian standard rules prescribe such a sand-test; they require the briquettes to be composed of one part cement and three parts dry sand (by weight), to remain in air for one day after gauging, and then to be placed in water for

a period of twenty-seven days; at the end of this period they are to be tested. The German rules in 1878 required the tensile strength of such briquettes to be 10 kilogrammes per square centimètre (142·22 lbs. per square inch); while the Austrian rules demanded 12 kilos. for the same area (170·7 lbs. per square inch). In 1887 the German standard was raised to 222·5 lbs. per square inch. Some German makers guarantee the minimum tensile strength of briquettes, made with their cement according to the standard regulations, to be 16 kilos. per square centimètre, or 227·5 lbs. per square inch. Thirty-three briquettes made from Messrs. G. & T. Earle's Portland cement and three parts sand, in accordance with the German rules, were tested by Mr. Faija in 1886, and gave an average strength of 251 lbs. per square inch at twenty-eight days. Dr. Michaëlis mentions one cement which, tested with three parts sand, broke with 457 lbs. per square inch at twenty-eight days.

There are two common objections raised against the sand-test; first, the great delay which a test extending over twenty-eight days involves (and briquettes containing sand, it must be remembered, cannot be fairly tested at an earlier date); and second, the difficulty, nay, almost the impossibility, of obtaining natural sand of such an uniform physical and chemical composition as will give always identical results. In Germany, a standard sand can be obtained from the Government testing-establishment at Berlin; this sand has all passed a sieve with 387 meshes per square inch, and has all been retained on one with 774 meshes in the same area. The second objection, therefore, loses in that country a great part of its force. But in England no such standard-sand exists, but any kind of sand, apparently, has been used, the only care being that the grains are of a certain size, usually such as have passed a sieve with 400 meshes to the square inch, and have been held by one with 900. Mr. Grant, however, the great advocate of testing cement with sand, declared in 1880 that he had "recently met with two sands which, though both clean, sifted through the same sieves, and not much unlike each other even under the microscope, gave results that differed by 50 per cent. From this," he continued, "it was clearly as important to test the quality of the sand or gravel used with cement as it was to test the cement itself."* This would be multiplying the difficulties of testing, and therefore we think Mr. Faija's suggestion, made after the reading of Mr. Grant's paper, a good one, namely, that cement should be tested neat, and that for the sand-test the sand used should be of the kind which would be used in the actual works for which the cement was required. This would give the architect or engineer a knowledge of the strength to which the particular structure about to be erected might be expected to attain. In Table ii. of the third of this series of articles (see *Builder*, p. 56, *ante*) will be found the result of tests by Mr. Grant on the strength of neat cement, and of cement and sand in different proportions.

A brief outline of the method of testing for tensile strength has been given in the eighth of this series of articles (see *Builder*, p. 153, *ante*), and the effect of the time of setting, &c., upon the tests will be considered hereafter.

Compressive Strength.—Testing by compression is seldom or never specified, but the results of such tests, especially with briquettes of cement and sand, are of interest, as such a test approximates more closely to the actual stress which the cement has to bear in certain parts of a building (foundations and arches, for instance), than does the test by tension. The shape of the briquettes largely influences the results, as it does in the case of tensile-tests. The resistance of cubes, columns, cylinders, &c., as can easily be understood, varies considerably. For comparison, cubes of a certain size would be most convenient.

The resistance which Portland cement offers to compression bears an approximate relation to that which it offers to tension, although the relation is not as uniform as in cast-iron and wrought-iron. Messrs. Dyckerhoff found that cements, tested under the same conditions as to area, &c., and with three parts of sand to one of cement, exhibited a resistance to compression twenty times as great as that they offered to tension, but this apparently is an abnormal ratio. Professor Bauschinger states that with nine cements the ratio between compressive and tensile strengths varied from 7 to 1 to 11 to 1. On the Continent it is usually considered that the resistance of a cement to compression should be ten times as great as its resistance to tension. Mr. Faija found that four cements gave results in which the ratio varied from about 7 to 1 to 9 to 1; at the age of 28 days, the resistance to crushing varied from 4,270 lbs. to 4,780 lbs. per square inch, and the resistance to tension from 480 lbs. to 696 lbs. These figures are the average of three tests in each instance; the briquettes crushed were only 1-in. cubes.

Considerable objection has been taken to the compression-test, because the slightest inequality of the surfaces of the briquette may cause fracture under a comparatively small stress. This is perfectly true when the briquettes are very small, but the difficulty is not insurmountable. If, instead of 1-in. cubes, 6-in. cubes were made, and brought to a smooth surface on two opposite sides with plaster of Paris, or in other suitable manner, and crushed, as in the case of building-stones, more accurate and uniform results of considerable value would be obtained. When the resistance of building-stones to crushing began to be tested, small cubes measuring 1 in. or 1½ in. or 2 in. each way were used, but the results varied to such an extent on account of the irregularity, &c., of the specimens that it was found necessary to test larger pieces. This was rendered possible by Kirkaldy's powerful machines. The larger pieces invariably gave higher results per square inch than the smaller; thus, nine experiments on 2-in. cubes of Yorkshire stone gave a mean resistance of 4·38 tons per square inch, while 6-in. cubes gave a mean of 4·91 tons; and 2-in. cubes of Bath stone (Box) crushed with ·66 ton per square inch, while 6-in. cubes required 1·5 tons per square inch to crush them. Mr. Faija's tests of 1-in. cubes of neat cement showed compressive strengths varying from 1·91 tons to 2·13 tons per square inch at the age of twenty-eight days, and increasing to three or four tons at the end of six months. Some tests by Mr. A. E. Carey showed the compressive strength of a neat cement to be at three months 7,392 lbs. per square inch, or 3·3 tons. Tests of larger concrete cubes will be given hereafter.

The following table is based on results obtained by Messrs. Dyckerhoff, and shows the relation between the tensile and compressive strengths of cement mortar containing sand and lime in varying proportions; the sand had all passed a sieve with 387 meshes to the square inch, and had all been retained on one with 774 meshes; the cement took four-and-a-half hours to set:—

TABLE XIII.

Tensile and Compressive Strength of Portland Cement.

Composition of briquettes by weight.			Tensile strength in lbs. per sq. inch.					Compressive strength in lbs. per sq. inch.				
Cement.	Lime in Dry State.	Sand.	Three of Sand.	Five of Sand.	Six of Sand.	Seven of Sand.	Eight of Sand.	Three of Sand.	Five of Sand.	Six of Sand.	Seven of Sand.	Eight of Sand.
1	...	3, 5, 6	224·8	138	91	...	...	4,822	2,341	1,549	...	...
1	...	3, 5	236·2	159·4	...	...	...	5,509	3,036	...	...	...
1	...	3, 5, 6	258·9	150·8	145·1	...	...	6,292	3,193	2,504	...	...
1	...	5, 6, 7	...	139·4	132·3	119·5	...	...	3,618	2,481	2,066	...
1	...	5, 6, 7, 8	...	128	133·7	99·6	86·8	...	3,412	2,716	1,941	1,643
1	...	6, 7, 8	...	...	115·2	91·1	74	...	...	3,521	2,535	1,847
1	1	8	...	...	...	...	76·8	...	...	...	...	1,871

These tests were all made on briquettes twenty-eight days old, the first four series having been kept in air one day and in water twenty-seven days, the last three series having been in air the whole time. The briquettes were only small, those subjected to tensile stress weighing about ·33 lbs. each, and the others about ·43 lbs. each.

Transverse Strength.—Mr. D. A. Stevenson specifies the following test of cement for small works, where a testing-machine cannot reasonably be required:—"The cement is to be made into blocks, 1 in. square and 8 in. long; these are to be immersed in water for seven days, and then tested by being placed on two supports 6 in. apart, when they must stand the transverse strain produced by a weight of 75 lbs. placed in the centre."*

Mr. Deacon, Water Engineer of Liverpool, contrived a simple apparatus for ascertaining the transverse strength of cement bars, by which no stress is put upon the bar by the weights until a lever is moved. He recommends that three bars of neat cement, 10 in. by 1½ in. by 1½ in., be made, kept in water for seven days, and then broken on supports 9½ in. apart; if not more than one of the three break with a weight of 150 lbs., the cement may be considered satisfactory.

For use in the formula $C = \frac{3LW}{2BD^2}$ Mr. Stevenson's test assumes the value of C to be 675, and Mr. Deacon's assumes it to be 633; these constants will give the breaking-weight (W) in lbs. Calculations will be much simplified if C be taken to equal six, the breaking-weight being then in cwts.; this will be near enough for all practical purposes, for a large factor of safety must always be used in calculating the safe load for concrete structures.

The following table has been compiled from figures given by Gillmore in his book on limes, &c. The bars were made in 1860, kept in water, and broken by a force applied at the middle, the ends being simply supported:—

TABLE XIV.

Transverse Strength of Portland Cement.

Proportion by volume.	Size of bars.	Clear span.	Age in days.	Average breaking weight in lbs.	Value of C to give result in cwts.	Remarks.
	in. in.	in.				
English Portland cement	2 × 2	4	320	1,536	10·3	Set under pressure of 32 lbs. per sq. in.
1 ,, to 1 sand ...	,,	,,	,,	1,263	8·4	
1 ,, ,, 2 ,, ...	,,	,,	,,	950	6·3	
English Portland cement	1 × 1	3	270	306	12·3	Not set under pressure.
1 ,, to 1 sand ...	,,	,,	,,	313	12·5	
1 ,, ,, 2 ,, ...	,,	,,	,,	204	8·2	
1 ,, ,, 3 ,, ...	,,	,,	,,	91	3·6	
1 ,, ,, 4 ,, ...	,,	,,	,,	74	2·9	
1 ,, ,, 5 ,, ...	,,	,,	,,	45	1·8	
1 Roman cement to 1 sand ...	2 × 2	4	100	585	3·9	Set under pressure of 32 lbs. per sq. in.

It will be noticed that the value of C deduced from these experiments is considerably more than is required by the tests of Mr. Stevenson and Mr. Deacon, but it must be remembered that the latter are for tests at seven days, whereas Gillmore's experiments are on bars 270 and 320 days old. The abnormal ratio of the first three tests in the second series seems to point to some error or irregularity in the testing.

OBITUARY.

MR. PHILIP HERAPATH, F.R.I.B.A.—Mr. Philip Herapath, of Auckland, New Zealand, died on June 29 last, after a brief illness. He was elected a Fellow of the Institute in 1886.

* "Proceedings of the Inst. C.E.," 1879-80, part iv.

* *Proceedings* Inst.C.E., vol. lxxxvii., pt. 1.

GENERAL BUILDING NEWS.

WARD'S SCHOOL FOR GIRLS, LONDON. — Mr. Andrew Murray, Surveyor to the City of London, has prepared some alternative plans and designs for a school which the Corporation are about to establish under provisions of the will of the late Mr. Ward. Having agreed upon one set, the Corporation will cause the new school to be erected upon a site next to the Guildhall School of Music, on the Victoria Embankment. It is hoped that room can be provided there for 400 pupils. It is stated that Mr. Murray's accepted design is in the Gothic style, and that the estimated cost is 15,400*l.*, with 2,000*l.* for the furniture and fittings.

NEW CHURCH, RATHMULLEN, DONEGAL, IRELAND. —On the 28th ult. the new Church of St. Joseph, Rathmullen, was dedicated by the Bishop of the diocese, the Rev. Dr. O'Donnell. The site of the church is on the face of a hill overlooking the pier and the lough. The church is designed in the Gothic style of the thirteenth century, and consists of nave, chancel, and sacristy. The nave measures 70 ft. by 30 ft., and the apse is 21 ft. in depth, and of octagonal form. The side walls are pierced by single lancet lights, of which there are five on each side, and the apse is lighted by three windows in the sides and end. The west end has a triplet, of which the centre one has a niche for a statue of St. Joseph, to whom the church is dedicated. The flanking windows of the niche show above the organ gallery, and are surmounted by a circular cusped rose-window. Buttresses are introduced, and these, as also the doors and windows, are all formed in Mount Charles cut stone. The roofs are high-pitched, with wrought principals and boarded ceilings, divided into panels by mouldings, the apse ceiling being treated with mouldings, and the whole varnished. The floors are of timber, and provision is made for three altars, those already erected being of timber. The church was designed by and carried out from the plans of Mr. Wm. Hague, architect, Dublin, and the builder has been Mr. James M'Clay, Strabane.

FREE LIBRARY, KIDDERMINSTER.—For the erection of the Free Library, in Exchange-street, Kidderminster, for the Corporation, the tender of Mr. Henry Smith, of Kidderminster, has been accepted, and the work commenced. Mr. Tomkinson, High Sheriff of Worcestershire, who is Chairman of the Free Library Committee, has consented to lay the foundation-stone. Mr. J. M. Gething, of Kidderminster, is the architect.

ADDITIONS TO GLASGOW POST OFFICE.—According to the *Scotsman*, the extensive additions which are being made to the General Post Office, Glasgow, at a cost of 30,000*l.*, are expected to be completed in the course of the next eighteen months. By securing the site of the old Athenæum, at the back of the present office, sufficient area has been provided almost to double, roughly speaking, the accommodation of the different departments, barring the public offices, which remain unaltered. The present building, in fact, is not in any way interfered with, except in so far as is necessary to connect it with the new structure in the rear. Having its front elevation towards Ingram-street, it has not been necessary to adhere to the original style of architecture, and the architect, Mr. W. W. Robertson, of Her Majesty's Board of Works, has adopted a Renaissance style. Of the extensions, the main feature, according to the plans, is the provision of three large rooms, each occupying the whole extent of one of the floors. On the ground floor there will be a new sorting-room, 128 ft. by 80 ft. in its internal dimensions, and connected with the old sorting-room, which is on the corresponding flat of the present office. Above, on the first floor, and of the same dimensions, is a new letter-carriers' room, and over it again is the telegraph-room, with large roof-lights in addition to the windows. All of these departments are similar in size, and the floor space, save for half a dozen supporting columns, is uninterrupted. The basement is taken up with the engine-room and the boiler-house required for the working of the pneumatic tubes, and the supply of the electric light, with which the entire office will be illuminated. In the basement also accommodation is found for the telegraph delivery-room and the telegraph messengers' kitchen. On either side of the building a covered way is to be constructed to enable the mail-carts to enter. The contractors are Messrs. M'Kessock & Son, Glasgow, and Messrs. Morrison & Mason, Glasgow.

VILLAGE HALL, FOREST-ROW, SUSSEX. — A village hall has just been erected at Forest-row, Sussex, by Mr. H. R. Freshfield, to the memory of the only grandson of Mr. and Mrs. Freshfield. The architect of the building is Mr. J. M. Brydon, of Regent's Park, London, the builder being Mr. Job Luxford. The exterior of the large hall is constructed of orange-red bricks from Swinley Forest, Bracknell, with cornices of local sandstone, and the heavy buttresses are also cased with it. The lower portion of the front of the building and its two wings is of local stone, the upper part being covered with ornamental vertical tiling from St. John's. The chimneys are of red bricks, and between them is a cubular turret covered with copper, and used for the purposes of ventilation. It contains one of Boyle's ventilators. The portico stands on wood columns, supporting wooden arches. It has a heavy cornice and old timbered front. In a lower panel, with a bordering scroll, is an inscription. The portico leads to a hall with a floor of small plain red tiles. This hall gives communication with the large meeting-room, the private apartments of the caretaker, a committee-room, and, by means of a staircase and balcony above, to another room which will serve as a place of gathering; and on the other side to the private sleeping apartments of the attendant. The large hall is 43 ft. by 23 ft., and will seat 250 people. At one end, in a recess, is a stage communicating with an ante-room having its own exit and entrance. There is a "crush-door" to the hall itself close to the stage, and a third door giving admission to the caretaker's rooms. The roof is of lofty pitch, and borne by timber principals. A panelled dado runs round the whole room. Warmth in winter will be supplied by a large open fire-place. Behind are hot-air chambers, with openings into the room through the mantelpiece. The apartment is lit by lead-light windows. Adjoining the hall is a soup-kitchen.

BOARD SCHOOL, SHEFFIELD.—The new school erected by the Sheffield School Board at Woodburn was opened on the 29th ult. by Mr. J. N. Coombe. The schools, which are close to the pit of the Nunnery Colliery Company, have been erected at a total cost of 14,730*l.* They are to accommodate 432 boys, 432 girls, and 360 infants. The plans were drawn by Messrs. Wightman & Wightman, but on the death of the principal partner of that firm the work, says the *Sheffield Telegraph*, was taken in hand by Mr. E. Holmes, of St. James's-row, Sheffield. The principal contractor was Mr. J. Mortcn, Sheffield; others doing different portions of work being Mr. T. Astley, carpenter and joiner; Mr. J. B. Corrie, plumber; Messrs. C. Chadwick & Sons, slaters and plasterers; Mr. E. Smith, painter; Mr. J. Scrimshaw, asphalter; Mr. R. White, ironworker. The gas-fittings were supplied by Messrs. W. Emery & Co., and the clocks by Mr. J. Dawson. The schools have been heated throughout on the low-pressure principle by Messrs. Newton Chambers & Co. The clerk of the works was Mr. Cartwright.

DRILL HALL, WINCHESTER.—The new Drill Hall referred to on p. 164 of our last issue is being erected at Winchester, not at Alton, as inadvertently stated.

SANITARY AND ENGINEERING NEWS.

PRECAUTIONS AGAINST THE CHOLERA. — The Local Government Board and the Port Sanitary Authorities of London and other ports appear to be taking prompt and vigorous measures to intercept and isolate cholera patients arriving from abroad. So far there appears to be no undue ground for alarm, but increased attention must be paid to sanitation, both domestic and public. The *Times* states that the Local Government Board has addressed letters to the London Water Companies which take their supplies from the Thames and Lea, representing to them the necessity of bestowing special attention on the filtration, of employing an extra thickness of sand, of allowing the water to pass through as slowly as practicable, and of taking care to remove all surface foulness from the layers of filtering material. Such of the Companies as derive part of their supply from deep wells in the chalk are also requested to distribute as much water from that source as possible, rather than river water. The local authorities are taking action for the setting-apart of buildings as isolation hospitals should they be needed.

BOYLE'S VENTILATING APPLIANCES IN THE EAST AND IN AUSTRALASIA.—We learn that Mr. Robert Boyle has just completed another voyage round the world (his fourth), in the interests of the ventilating and sanitary appliances of which he is the inventor, and which are manufactured by Messrs. Robert Boyle & Son, Limited, of London and Glasgow. Two years ago Mr. Boyle made his third tour round the world, when he visited Egypt, India, China, and Japan, and last year he travelled through South Africa. On both of these journeys we learn that he was highly successful in stimulating an interest in sanitary matters, and in securing the adoption of his systems of ventilation and sanitation. Mr. Boyle has been no less successful throughout the tour just concluded, in the course of which he visited Burmah, the Malay Native States, Sumatra, Siam, Borneo, Java, Australia, New Zealand, Samoa, the Sandwich Islands, and America, where he saw the different buildings comprising the Chicago Exhibition, and furnished plans and estimates for their ventilation. We may mention that the Kimberley Exhibition, South Africa, is ventilated throughout with Mr. Boyle's system. Agencies have been established in the different countries visited, and arrangements completed in each of the Australian colonies and New Zealand for the manufacture of the latest improved form of the self-acting air-pump ventilator, and other ventilating and sanitary appliances. As evidence of the confidence of the agents appointed in Australasia with regard to business prospects, it may be stated that they have undertaken to sell, within a specified time, not less than 16,000*l.* worth of the air-pump ventilators, &c., representing ventilating contracts of the value of about 40,000*l.*; though at least double that amount of business is confidently expected to be realised. The Boyle system is specified for the New Jubilee Hall to be erected in Rangoon, and Mr. Boyle has furnished plans and estimates for the ventilation of the Palace of the King of Siam, at Bangkok; Government Buildings and Museum, Batavia; Houses of Parliament, Centennial Hall, Municipal Buildings, Hospital, and New Theatre, Sydney; Houses of Parliament, Stock Exchange, Commercial Bank, and Bank of Victoria, Melbourne; also a system of ventilation for the new drainage scheme in Melbourne. At Adelaide the air-pump ventilators are employed for the ventilation of the Houses of Parliament, Government House, Government Buildings, Supreme Courts, Post Office, Hospital, Art Gallery, Museum, University, and other public buildings. At Christchurch, New Zealand, the house drainage is, we are informed, in accordance with the drainage regulations, exclusively ventilated with the air-pump ventilators, and it is estimated that there are over 5,000 in use for this purpose in Christchurch alone; most of the public buildings are also ventilated with the Boyle system. The air-pump ventilators are also employed for the house drainage, Wellington, several thousands being fixed. They are also in use on the Houses of Parliament, Government House, Government Buildings, Post Office, Supreme Courts, Hospital, Opera House, &c., whilst at Dunedin and Auckland Boyle's system is likewise in general use. Mr. Boyle informs us that he has received a large number of reports from Government engineers, architects, and City Surveyors, testifying to the success of his system in the Colonies.

FOREIGN AND COLONIAL.

FRANCE.—It is announced that the architectural department of the municipality of Paris is to undertake shortly the restoration of the celebrated tower of "Jean sans Peur" in the Rue Étienne Marcel, which has been long in a dangerous condition.——The "Société d'Histoire et d'Archéologie du Vieux Montmartre" has requested of the Paris municipality that the statue of Claude Chappe, inventor of the aërial telegraph, should be placed on the Boulevard de Rochechouart, in memory of the first telegraph established in 1793 on the tower of the Église St. Pierre.——An international exhibition of Industry, Horticulture, and Fine Arts is to be held at Monaco during the months of January, February, and March of next year. ——To-morrow (September 4) is to be inaugurated the colossal statue by M. Falguière symbolising the union of Savoy and France in 1793. The statue, which is in bronze, stands on a pedestal 3½ mètres in height, ornamented with a bronze garland binding together the escutcheons and coats-of-arms of the seven ancient provinces of the Duchy of Savoy.——At Lille the competition for a monument to M. Testelin has just been decided; the design of M. Cordonnier has been selected, consisting of a bust on a column, beneath which is a figure with outspread wings representing "La Défense Nationale." At the foot of the column are grouped soldiers, one of whom unfolds a standard while the other sounds a charge, while a seated figure symbolises "La République Parlementaire." —— The committee formed at Epinal for the erection of a national monument to Joan of Arc has entrusted its execution to M. Mercié. The monument, which will be of marble, is to be finished in about a year from now, and will probably be exhibited in the next Salon.——M. Théophile Banau (sculptor) will shortly complete a statue of General Kellermann for the monument in commemoration of the battle of Valmy, which will probably be inaugurated at the end of the month of September. On the occasion of the ceremony a retrospective exhibition is to be organised at Châlons-sur-Marne of various objects connected with that battle, which are already collected to the number of more than three hundred, and include arms, manuscripts, plans, orders, drawings, and uniforms.——The Town Council of Pontacq (Basses Pyrenées) has decided to raise a statue to General Barbanègre, a celebrated soldier of the First Empire, who was born in that locality. It is Barbanègre who forms a prominent figure in M. Détaille's picture of the surrender of Huningue, exhibited in this year's Salon.——The Decauville Railway Society has opened a new line from Cabourg to Lue-sur-Mer.——A new railway line has been opened from Arles to Saintes Maries, traversing the plain of Camargue. ——The decease is announced, at the age of seventy-six, of M. Geoffroy Dechaume, curator of the museum of sculpture at the Trocadéro. An eminent sculptor and passionate lover of French art, he contributed largely to the restoration of the Mediæval sculpture of the country. He was a zealous collaborator with Viollet-le-Duc in the restoration of the Sainte Chapelle. He modelled the fine medallion of Corot which adorns the monument of that painter at Ville d'Avray, as well as the marble statue of Béranger on his death-bed, which is one of the best works in the Luxembourg; and he rendered great service in the organisation of the Trocadéro Museum, and in overseeing the casting of the examples, as well as in the selection of works to be reproduced.

COMPETITIONS AND CONTRACTS.

COMPETITIONS.

Nature of Work.	By whom Advertised.	Premium.	Designs to be delivered.
*Local Board Room, Offices, &c.	Shepton Mallett L. B.	15*l.* and 5*l.*	Oct. 1
*Local Board Offices	Crompton Local Board	40*l.* and 20*l.*	Nov. 1

CONTRACTS.

Nature of Work or Materials.	By whom Required.	Architect, Surveyor, or Engineer.	Tenders to be delivered.
*Road Materials	Bromley Local Board	*Official*	Sept. 6
*Compound Horizontal Engine, Extension of Boiler Houses, &c. &c.	Wisbech Wtrwks Co.	E. Easton & Co.	Sept. 7

CONTRACTS.—*Continued.*

Nature of Work or Materials.	By whom Required.	Architect, Surveyor, or Engineer.	Tenders to be delivered.
*Pulling-down Gas Works	Central London District School	*Official*	Sept. 8
*Repairs to Roofs, Parapets, Walls, &c. at Infirmary	Kensington Guardians	T. W. Aldwinckle	do.
*Subway at Workhouse	do.	do.	do.
*Rebuilding Shop and Warehouse, Chelsea	.....	T. Lawrie	do.
*Builders' Work in Engine and Boiler House, &c.	Derby Corporation	Bramwell & Harris	Sept. 12
*Erection of Schools, &c.	Llanelly School Board	J. B. Morgan	do.
*Buildings and Works at Depot	Lewisham Bd. of Wks	*Official*	Sept. 13
*Roadmaking and Paving Works	do.	do.	do.
*Cart Lodges in Yard, Deptford	Greenwich Bd. of Wks	do.	Sept. 14
*Cemetery Chapels, Lodges, &c.	Northfleet Local Bd.	Mr. Walford	Sept. 19
*Alteration to House at Cemetery, Ilford	Commrs. of Sewers	*Official*	Sept. 20
*Brick and Pipe Sewers, &c. &c.	Skipton U.R.S.A.	A. E. Preston	Sept. 22
*Public Baths	Woolwich Local Board	H. H. Church	Sept. 27
*Repairing Blinds, &c. at Infirmary	St. Olave's Union	*Official*	Sept. 29

Those marked with an Asterisk (*) are advertised in this Number. ***Competitions, p.* iv.** ***Contracts, pp.* iv., vi., & viii.**

MISCELLANEOUS.

THE MANCHESTER ROYAL INFIRMARY AND THE PROPOSED EXTENSION.—A meeting of the Board of the Manchester Royal Infirmary was held on the 29th ult., Mr. E. S. Heywood in the chair. The report of the scrutineers to examine and count the voting papers handed in in connexion with the vote taken as to the proposal of the Board to extend the Royal Infirmary upon the present site, stated that 1,350 papers were issued, and 698 were returned. Of that number 414 trustees voted for the amendment, and 284 for the resolution of the Board. Five votes were handed in too late. The amendment was therefore carried by 130 votes.—The Chairman said the result had been a disappointment to the Board. They had, however, matter for satisfaction in finding that during the last twelve months the strain upon the Infirmary wards had not been so heavy as upon some former occasions, and so time could be allowed for deliberation.

THE RAILWAY ACCIDENT NEAR MELTON MOWBRAY.—Major Marindin has issued his report to the Board of Trade on the accident near Melton Mowbray, on the Great Northern and London and North-Western joint line, which occurred on July 25, and caused the death of three persons. It will be remembered that at the time of the accident a section of the up-line north of Melton Mowbray was being re-sleepered. Notices were sent out limiting the speed at the place where the accident took place to fifteen miles an hour. Part of the line was originally laid over 7 ft. from the down-line, and it was arranged that when the work of re-sleepering was being performed the line should be brought into the usual position, with a 6 ft. space only between the two lines. There was a conflict of testimony as to when this re-arrangement was to be effected. At the time the accident happened, about 158 yards of the line had been nearly slewed into its new position, and for a considerable distance northwards the line had been prepared for the change by the excavation of the ballast. There were no flagmen out, and the signalman, having had no notice of what was going to be done, had lowered both his home and distant signals for the train. The engine jumped off the line towards the 6 ft. side, about 42 yards south of the most northerly point to which the slewing had actually been carried out. Major Marindin says it is clear that the line was at the time rendered quite unfit for a train to run over at any speed, and the speed at which the train was running when it left the rails was considerably over 15 miles an hour. The responsibility for the accident he attributes principally to the foreman, George Harwood, who failed to send out flagmen, but he adds that it is impossible to acquit the unfortunate driver, Herron, who was killed, from the charge of non-attention to the notice which had been handed to him limiting the speed of the train at the point to 15 miles an hour, as at that speed the train might have run over the portion of the line which had been slewed. Major Marindin considers that such an operation should always be protected by flagmen.—*Times.*

AMERICAN "SOCIAL" STATISTICS.—Amongst the various bulletins issued by degrees from the Census Office of the United States on the results of the 1890 census, perhaps none is more interesting than that dealing with "social" statistics of cities. The latter include density of population and death-rate, street paving and lighting, waterworks and sewers, police and fire services. Confining ourselves to street paving and lighting, waterworks and sewers, the chief thing that strikes us is the great differences prevailing between the different cities. Of the five largest cities, Philadelphia has the highest percentage of streets paved, namely, 65·16 per cent., while at Chicago it is only 30·71 per cent. At New York it is 62·26 per cent.; at Brooklyn, 57·43 per cent.; at St. Louis, 39·77 per cent. Washington is well up in the list with 69·36 per cent. At Boston, Worcester, and Holyoke (all in Massachusetts), all the streets are paved. None of the streets of Denver (Colorado) are paved. The average cost of the construction and repair of streets per head of the population is highest in Sioux City (Iowa), where it is 20·25 dols., and lowest in Newark (New Jersey), namely, 11 cents. The figures for the five largest cities are:—Chicago, 3·18 dols.; St. Louis, 1·85 dol.; New York, 68 cents; Philadelphia, 61 cents; Brooklyn, 49 cents. The average cost per head of the population for street cleaning ranges from 71 cents in New York to 5 cents in Buffalo (New York). The annual cost of street lighting per head of the population is highest at Boston, where it is 1·24 dol., and lowest at Buffalo (11 cents). In Washington it is 77 cents; Philadelphia, 70 cents; Brooklyn, 59 cents; Chicago, 58 cents; New York and St. Louis, 43 cents. The annual charge for water for an average dwelling is highest at Dallas (Texas), namely, 31 dols., and least at Washington (4·50 dols.). At Chicago and St. Louis it is 14 dols.; Boston, 12 dols.; Philadelphia, 9 dols.; Brooklyn, 8 dols.; New York, 6 dols. The average cost of the works per head of the population was 21·35 dols. in the case of waterworks owned by the cities, and 31·20 dols. in the case of works owned by private parties,—a difference worth noting. As regards sewers, the average cost per head of the population is highest at Holyoke (0·561 dol.), and lowest at Philadelphia (0·024 dol.). At Boston it is 0·263 dol.; Washington, 0·119 dol.; New York, 0·077 dol.; Chicago, 0·075 dol.; Brooklyn, 0·066 dol.; St. Louis, 0·057 dol.

THE MACKENZIE TOMB IN GREYFRIARS CHURCHYARD, EDINBURGH.—A remarkable tomb in Greyfriars Churchyard, Edinburgh, has just been restored by the care of Lord Wharncliffe and the Marquis of Bute, under the careful superintendence of Dr. Rowand Anderson. The tomb is that of Sir George Mackenzie, King's Advocate to Charles II. and James II. We gather from the *Scotsman* that "the disordered and ill-cared-for state of the remains of the Mackenzie family, due, no doubt, partly to the mode of burial, was reflected in the monument itself. The entire plaster work inside was dropping off with damp, the stones in the roof of the dome were being forced from their places by frost and vegetable growth. The vase or urn on the top was split into several pieces, and ready to come down at the slightest provocation. The old oak door was much decayed. All these defects have been repaired. The monument, without alteration in form, has been made wind and water tight, and its outward appearance decent and creditable to the representatives of its founder, so that it may carry down for several centuries longer the name and fame of Sir George Mackenzie. The tomb is one of the most important in the churchyard. In plan it is a circle inside of 12 ft. diameter and an octagon outside. At each angle of the octagon is a Corinthian column carrying the entablature and cornice. On each face of the octagon is a shallow niche with a carved shell in the semi-circular head. The door into the tomb is on the north side; over it is a carved panel on which is represented a skeleton holding in front of it something like a shell, on the inside of which is a cartouche on which Mackenzie's crest is carved—an eagle rising from a rock, with the motto, 'Firma et Ardua.' There is no name or date on the building. The roof is a stone dome showing a circular section inside and an ogee section outside. The finial is a carved vase. The inside, about 20 ft. high, is divided into eight compartments, each having a shallow niche somewhat similar to those outside. The roof is divided by eight ribs, meeting in the centre in a circular boss, on which is carved the emblem of the Mackenzies—a stag's head in a wreath of deer's grass. On the side opposite the door is a recess about 7 ft. long, 3 ft. 9 in. broad, and 2 ft. 3 in. from the floor. In the floor of this chamber is a large opening with a stair leading to the vault below, where there are a number of coffins, but not that of Sir George Mackenzie. Beneath this is a third chamber, access to which is obtained by raising a large flagstone with rings. In this chamber are also human remains. This tomb must have been erected some time about 1690. It is now the property of Lord Wharncliffe, the representative of the Mackenzie family. No mark exists to show who was the architect. From the date of its erection it may have been Robert Mylne, the Royal Master Mason of Mackenzie's time, who made additions to Holyrood for Charles II. took part in completing Heriot's Hospital, and is himself buried at Holyrood." Whilst the tomb of the "Bloody Mackenzie," the prosecutor of the Covenanters, has thus been restored, the burial place of John Knox, the Scottish Reformer, remains unmarked by any monument, and is left exposed to rolling vehicles and all the traffic of a public square. An unknown individual has, however, through a firm of solicitors, informed the Town Council of his willingness to erect an ornamental metal railing round the Reformer's grave in Parliament-square. He also stated that if the people of Scotland or of Edinburgh would be willing to enter into the movement, he would undertake to contribute at least 500*l.* towards placing a more substantial and worthy memorial over the grave. The letter has been remitted to the Lord Provost's Committee for consideration. The site of John Knox's grave is immediately to the south-west of the equestrian statue of Charles II., which occupies the centre of the square, and within a few feet of the pedestal of that statue. The site is most unsuitable for a monument, and to enclose it with a railing would so contract the passage of vehicles that it is hardly probable that the Government would sanction such an obstruction of the roadway to and from the Courts of Law. As we stated in a recent note, an endeavour to raise a memorial to Knox of a monumental character has failed, and that it is now proposed to place a statue of the Reformer in one of the niches of the National Portrait Gallery.

THE ENGLISH IRON TRADE.—There is still little alteration of note in the English iron market. In the Cleveland district business is fairly active, and prices are firm, at an advance of 9d. on the week. The Glasgow warrant market is more active; but transactions are confined to Scotch warrants. Scotch makers' iron is in less brisk demand, but rates are firmly upheld, and in the case of several brands are higher, owing to scarcity of supplies. In manufactured iron little is doing, and ship, girder, and boiler plates have been reduced 2s. 6d. in the Cleveland district. Tin-plates are in fair sale, but at very low prices. The steel trade exhibits little activity, and, as in finished iron, lower quotations are recorded in the north of England. Shipbuilders are depressed, and engineers are indifferently employed. The coal trade is quiet.—*Iron.*

MEETINGS.

TUESDAY, SEPTEMBER 6.

Glasgow Architectural Association.—Paper by Mr. Charles R. M'Intosh entitled "An Italian Tour." 8 p.m.

WEDNESDAY, SEPTEMBER 7.

Builders' Foremen and Clerks of Works' Institution.—Ordinary Meeting. 8.30 p.m.

RECENT PATENTS:

ABSTRACTS OF SPECIFICATIONS.

8,292.—ARTIFICIAL STONE BLOCKS: *G. M. Graham.*—This invention relates to artificial stone blocks for building purposes, as well as for street and side-walk pavements, and consists in the peculiar formation of the protuberances by which interlocking joints or seams of the building blocks are attained, the object of which is to so form the joggles or dovetails of the blocks as to permit joining them in close proximity on all the sides or faces of the seam, to reduce the building material for the same, and to increase its strength.

12,480.—PAINTS: *J. C. Martin.*—This invention consists in treating or operating upon pigments of which zinc oxide or zinc sulphide form a part, also upon the white lead produced by any of the precipitation or wet processes of manufacture, and, as these pigments are generally of inferior specific gravity and body, and require an excess of oil for conversion into paint, causing them to condense and assume the paste-like condition of ground white lead with a moderate quantity of oil, the inventor takes the pigment in the form of a dry powder, and places it in a horizontal pug-mill, or other suitable mixing apparatus, and adds as much water as when intimately mixed will produce a slightly damp powder. This damp powder is then submitted to the action of edge-runners, or other suitable crushing machinery, until the bulk is considerably reduced

and the specific gravity increased. It is then dried, and treated in the same manner in a similar apparatus, oil being substituted for the water in such quantity as will cause it to remain in a perfectly powder-like condition in the mixer above described, but will cause it to slightly adhere together when the crushing is completed under the edge-runners. It is then transferred to the ordinary pug-mills, and as much oil added as will bring it to a paste-like condition, after which it is ground in the usual manner.

12,633.—ARTIFICIAL STONE: *T. D. Harries.*—This invention consists in mixing cements in proper proportions with metalliferous matrix after the separation of the contained metals as far as practicable by the usual processes. The cement and mine *débris* mixture is placed in moulds, and moistened with sufficient mortar. The artificial stone thus produced consists of metalliferous matrix, containing various proportions of various metals, cement, and mortar.

14,773.—WATER-CLOSETS: *S. Jennings and J. Morley.*—This invention relates to water-closets which are emptied by syphoning. In such closets inconvenience is caused by the pouring of slops into the pan starting syphonic action, leaving the pan empty and the trap unsealed, if the handle is not pulled to admit fresh water. To obviate this objection the following arrangement is adopted:—The supply-pipe from the water-waste preventer, or other source, is branched at the bottom, one branch leading into the pan in the ordinary manner, whilst the other branch is led first downwards, then upwards, and again downwards into the top of the long leg of the syphon-pipe from the pan. At the top bend of the water-pipe is fixed a valve opening inwards. If slops are poured into the pan this valve admits air, and prevents any syphonic action being set up, but when the handle is pulled the flow of water is divided, part flushing the pan in the ordinary manner, whilst part rushes past the air valve and holds it closed, so that no air can enter. This water also in flowing down the long leg of the syphon starts the syphonic action, and empties the pan, which is afterwards filled with clean water by the usual after-flush apparatus.

16,309.—SCAFFOLDING: *F. Weldon.*—The main object of this invention is the construction of a device to be employed in erecting scaffolding in place of the rope lashings ordinarily used, and this device consists of a short length of wire rope or chain, furnished with a loop or eye at each end. To one of these loops is attached a double hook, the ends of the hooks being bent downwards and sharpened to form spikes. To connect a horizontal pole to a vertical pole the rope is placed round the vertical pole below the horizontal pole, then brought round the latter, and crossed on the vertical pole, the ends being then brought round the said pole, and united by entering the double hook in the loop, so that the spikes are against the pole. These spikes entering the wood are sufficient to retain the device in place, and the arrangement is such that the greater the weight brought to bear upon the horizontal pole the more rigid the attachment becomes. At the same time, the position of the horizontal pole can be instantly adjusted by pressing up the lowermost part of the rope. This slackens the whole arrangement, and the short spikes being pulled out of the wood the horizontal pole and rope can be moved up and down as required, whilst directly the weight is allowed on the rope the device again becomes rigidly attached. Although described in connexion with a horizontal and vertical pole, it is equally applicable for securing a diagonal to a vertical pole.

9,266.—BRICK DRYING: *Max Wolff.*—The object of this invention is to provide a construction adapted for drying bricks in hot-air dryers of the class in which the material to be dried is moved slowly through the dryer on cars. For the drying of lumber, kilns of this general character have long been known and successfully used, and numerous and expensive attempts have been made to employ the same principle in the drying of bricks. These attempts have been hitherto without success. In this invention the excessive moistening of the bricks near the entrance end, and the cracking of the bricks as they progress through the kiln, have been entirely obviated, and the bricks may be dried with the same certainty, uniformity, and success as lumber may be dried in kilns of this general character. For details we must refer our readers to the specification, as they are too complicated to be adequately described in the space at our command.

11,193.—WATER-CLOSETS: *P. Bright.*—This invention relates to that kind of water-closet the basin of which is formed with an apron, skirt, or shield in front, which usually extends more or less round the sides, and which supports the weight of the basin and of the person using the closet. It consists, firstly, in forming the upper part of the basin with a lip, or projecting part, in front, somewhat after the shape of the basin of an urinal; secondly, in forming the apron, skirt, or shield of less depth than hitherto, and in supporting the basin on a frame or stool, the apron, skirt, or shield being provided with an inwardly-projecting flange at the bottom, or with inwardly-projecting lugs, whereby it may be bolted to the aforesaid frame or stool, which latter is also adapted to support the trap; and, thirdly, in forming the outlet from the closet-basin horizontal instead of vertical, as in Mr. Drayson's patent, such horizontal outlet forming one half, or thereabouts, of the trap.

11,407.—ENAMELLED BRICKS: *C. F. Hall.*—This patent relates to an improved method of enamelling or glazing bricks or tiles. This is effected by heating the surface which it is proposed to enamel, and applying to this surface a sufficiency of finely-powdered enamel of a composition such as is described in the specification, so as to coat and glaze the surface. The brick or tile is afterwards annealed.

NEW APPLICATIONS FOR LETTERS PATENT.

August 15.—14,673, W. Greaves, Domestic Fire-grate or Stove.—14,681, J. Helliwell, Apparatus for Carving Wood, &c.—14,689, J. Cochrane, Immovable Buffer for Water-closet Seats.—14,698, C. Price, Combination Drain-plug.—14,724, E. Edwards, Feeding and Driving in Nails.—14,726, G. Harper, Compound or Composition for Cleaning or Removing Paint and Varnish, or for Cleansing Wood, Metal, and Stone.

August 16.—14,746, C. Allen and R. Ison, Contrivances for Securing Joists to Beams.—14,776, L. Young, Telescopic Tubular Window Ventilator.—14,794, G. Coleman, White Lead and other Lead Pigments.—14,795, J. Koch, Hydraulic Brick Presses.

August 17.—14,831, E. Hoyle, Fastening Sashes.—14,839, H. Atkinson, Ovens and Kilns for Burning and Drying Bricks, Tiles and similar Articles of Earthenware.—14,888, J. Day, Water-closets, more especially in Closets for Utilising Waste Water.—14,871, W. Drayson, Starting Syphons of Flushing Cisterns.—14,888, R. Kissfert and H. Thurion, Paints.

August 18.—14,910, G. Rose, Ventilation.—14,914, J. James, Chimney-pot or Chimney-pot Attachment; also Applicable as a Ventilator.—14,917, J. & C. Tildesley, Door Knobs.

August 19.—14,954, L. Russell, of the firm of Saunders, Davies, & Co., Raising, Lowering, Adjusting, and Fastening the Sashes of Windows.—15,003, J. Waddington and J. Pendlebury, Devices or Means for Retaining Windows or Doors in any desired Position.—15,007, J. Winslade, and J. Jenkins, Door-check or Fastener.

August 20.—15,018, E. Partridge, Scaffold and Means for Attaching same to a Ladder.—15,045, A. Fowler, jun., Water-closets.

PROVISIONAL SPECIFICATIONS ACCEPTED.

11,127, J. Webb, Ventilating Sewers.—12,455, H. Tippet, Nails.—12,922, C. Taylor, junior, Planing or Shooting Mitres.—13,232, C. Gartel, Water-closet Basins.—13,244, E. Turner, Self-flushing House or Sewer Drains.—13,251, J. Adair, Bakers' Ovens.—13,435, J. & W. Shellock, Nails.—13,577, J. Mackleish, Smoke-testing Machines for Testing Drains, Soil and Waste Pipes.—13,753, E. Wiseman & J. Holroyd, Water-waste Preventers or Flushers.—13,825, W. Hartley & W. Blenkinsop, Waterproof Coverings for Roofs and other such like purposes, or as a substitute for glass.—13,883, J. Kirkman, Flushing Cisterns for Water-closets.

COMPLETE SPECIFICATIONS ACCEPTED.

(Open to Opposition for Two Months.)

17,802, W. Wooler, Interlocking Roofing Tiles.—17,881, C. Shopee, Facing Bricks.—18,085, A. Foppl, Roofs.—12,174, O. Terp, Artificial Stone and Hard Compositions applicable to Building and Paving purposes, to Moulds for Cement Castings, to Safes, &c.—12,539, H. Poole, Ventilating Buildings or Structures.—13,220, H. Leigh, Enamelled Bricks.

SOME RECENT SALES OF PROPERTY:

ESTATE EXCHANGE REPORT.

AUGUST 23.—By *Richardson & Barton*: 10, Alma-st., Kentish Town, u.t. 32 yrs., g.r. 4*l.*, 280*l.*; 296, 298, and 300, York-rd., and 1, Warple Way, Waudsworth, u.t. 65 yrs., g.r. 12*l.*, 550*l.*—By *F. J. Bisley & Sons*: 27, Lower-rd, Rotherhithe, u.t. 49 yrs., g.r. 12*l.* 10s., 220*l.*; 19 and 21, Dilston-grove, u.t. 58 yrs., g r. 10*l.*, 320*l.*—By *Worsfold & Hayward* (at Ashford): Enclosures of land, 13a. 3r. 3p., f., Lyminge, Kent, 530*l.*; f. dwelling-house, r. 10*l.*, 220*l.*; f. marsh land, 24a. 3r. 24p., Newchurch, Kent, 1,350*l.*

AUGUST 24.—By *J. Baker & Son*: 70, Carlton-vale, Kilburn, u.t. 69 yrs., g.r. 10*l.* 10s., r. 50*l.*, 450*l.*; 66, Carlton-vale, u.t. 69 yrs., g.r. 10*l.* 10s., 425*l.*; enclosure of f. land, Ruislip, Middlesex, about 4 acres, 425*l*

AUGUST 25.—By *Stimson & Sons*: F.g.r. of 14*l*, Rye-lane, Peckham, reversion in 51 yrs., 360*l.*; f.g.r. of 10*l.* 10s., ditto in 76 yrs., 270*l.*; Atwell-rd., f.g.r. of 5*l.* 17s. 6d., ditto in 59 yrs., 170*l.*; 72, Welbourne-rd., Tottenham, u.t. 85 yrs., g.r. 6*l.*, r. 30*l.*, 200*l.*; 44 and 46, Cavendish-rd., Harringay, f. 700*l.*; 10, Ada-rd., Camberwell, u.t. 80 yrs., g.r. 5*l.* 5s., r. 36*l.* 8s., 195*l.*; 25 and 26, Pulross-rd., Brixton, u.t. 72 yrs., g.r. 9*l.* 10s., r. 72*l.* 16s., 475*l.*; 39, Chantry-rd., u.t. 79 yrs., g.r. 7*l.*, r. 35*l.*, 270*l.*; 38, Stansfield-rd., u.t. 78 yrs., g.r. 6*l.* 6s., r. 35*l.*, 270*l.*; 39, Ellison-rd., Streatham, u.t. 87 yrs., g.r. 10*l.*, r. 36*l.*, 235*l.*

[*Contractions used in these lists.*—F.g.r. for freehold ground-rent; l.g.r. for leasehold ground-rent; i.g.r. for improved ground-rent; g r. for ground-rent; r. for rent; f. for freehold; c. for copyhold: l. for leasehold; e.r. for estimated rental; u.t. for unexpired term; p.a. for per annum; yrs. for years; st. for street; rd. for road; sq. for square; pl. for place; ter. for terrace; cres. for crescent; yd. for yard, &c.]

PRICES CURRENT OF MATERIALS.

TIMBER.		
Greenheart, B.G. ton	9/0,0	0,0 0
Teak, E.I... load	9/10/0	15/0/0
Sequois, U.S.ft.cu.	2/4	3/0
Ash, Canada load	2/10/0	4/0/0
Birch, do.	3/5/0	4/10/0
Elm, do.	3/10/0	4/15/0
Fir, Dantzic, &c.	1/10/0	3/10/0
Oak, do.	3/0/0	5/5/0
Canada.....	5/10/0	7/0/0
Pine, Canada red	2/10/0	3/10/0
Do, yellow	2/10/0	5/0/0
Lath, D'ntzic, fath	5/0/0	6/0/0
St. Petersburg	5,0 0	7/0 0
Deals, Finland 2nd & 1st std 100	7/10,0	9/10,0
Do, 4th & 3rd..	7/0/0	8/0/0
Do. Riga	6/10,0	8/0 0
St. Petersburg, 1st yellow ..	10/10,0	14/10/0
Do. 2nd yellow	8/0/0	9/10/0
Do. white	7/10/0	10/0/0
Swedish	7/0/0	15/10/0
White Sea	8/0/0	17/0/0
Canada, Pine 1st	20/0/0	26/0/0
Do. do. 2nd....	14/10/0	16/0/0
Do. do. 3rd, &c.	8/0/0	10/0/0
Do. Spruce. 1st	8'10/0	11,0 0
Do. do. 3rd & 2nd.....	6/15,0	8/0/0
New Brunswick	7/0,0	7/10/0
Battens, all kinds	3/10/0	15,10 0
Flooring Boards, sq., 1 in. prep. 1st	0'8/0	0 13/6
Do. 2nd.....	0/7/0	0'10/6
Other qualities	0/3'6	0'8/0
Cedar, Cuba ..ft.	/3½	/4½
Honduras, &c.	/3½	/4
Mahogany, Cuba.	/4½	/6½
St. Domingo, cargo av	/4½	2/0
Mexican do. do	/4	/5
Tobasco do. do	/5½	/7
Honduras do..	/5e	/6½
Box, Turkey ton	4/0/0	13/0/0
Rose, Rio.....	10/0,0	20/0/0
Bahia	9 0 0	18,0 0
Satin, St. Domingo ....ft.	0'0/8	0/1/3
orto Rico	0,0/8	0/1/6

TIMBER (*continued*).		
Walnut, Italian..	0 0 3½	0'0/7
METALS.		
IRON—Pig, in Scotland .....ton	2/1/10½	0/0/0
Bar, Welsh, in London.....	5/17/6	6/0/0
Do. do. at works in Wales	5/7/6	5/10/0
Do. Staffordshire, in London	6'5/0	6/15,0
COPPER—British, cake and ingot	46/15/0	47/5/0
Best selected ..	48/0/0	48,10/0
Sheets, strong..	56/0/0	0/0/0
Chili, bars	44/7/6	44/15/0
YELLOW METAL lb.	0/0/4½	0'0/5½
LEAD—Pig, Spanish....ton	10/5'0	10/6/3
English, com. brands	10,7/6	10/10/0
Sheet, English, 3 lbs. per sq. ft. and upwards ..	12/5/0	0 0 0
Pipe	12/15/0	0/0,0
ZINC—English sheet .....ton	25/0/0	0/0,0
Vieille Montagne.....	25/10/0	0 0,0
TIN—Straits	92/17/6	93,7/6
Australian	93/12/6	94 2/6
English Ingots..	96/0 0	96/10 0
Banca	94/10/0	0/0/0
Billiton	93/10/0	9/0/0
OILS.		
Linseed .....ton	18/0/0	18/2 6
Cocoanut, Cochin	24/10.0	24/15/0
Do. Ceylon	21/10/0	21/15 0
Palm, Lagos	23/0/0	0/0/0
Rapeseed, English pale	24/10/0	0/0/0
Do. brown	22/12/6	0/0/0
Cottonseed ref...	18/5,0	0/0/0
Oleine	20/10/0	21/0/0
Lubricating, U.S.	4/0/0	5/0/0
Do. refined	5/10/0	12/0/0
TAR—Stockholm barrel	0/19/6	0/0/0
Archangel	0/12/6	0/0/0

TENDERS.

[Communications for insertion under this heading should be addressed to "The Editor," and must reach us *not later than* 12 *noon on Thursdays.*]

ABINGDON.—For new premises, High-street, Abingdon, for Mr. J. C. Clarke. Mr. J. G. T. West, architect, Abingdon:—

T. Kingerlee.....	£1,030	J. Buckle	£826
Wilkins & Sons	998	G. Wheeler	815
W. Goodchild, Reading*..	852		

* Accepted.

ANNESLEY WOODHOUSE (Notts).—Accepted for building Wesleyan schools, Annesley Woodhouse. Mr. J. Wills, architect, Derby:—

J. Munks, Hucknall Torkard £703 10 0

BIRMINGHAM.—For the erection of a dwelling-house, Willows-crescent, for Mr. F. Thompson Brown. Mr. W. J. Ballard, architect:—

W. Hopkins	£619	W. Ambler* (modified)	£497
Gazey & Son	596		

* Accepted.

BIRMINGHAM.—For the erection of a dwelling-house and stable, Cannon-hill, for Mr. G. H. Mullis. Mr. W. J. Ballard, architect. Quantities by the architect:—

Robinson	£630	W. Hopkins	£561
Lidzey & Evans	568	W. Ambler (modified)*	497

* Accepted.

BIRMINGHAM.—For the erection of two villa residences, Edgbaston, for Messrs. H. Bowley and Alfred Wallis. Mr. W. J. Ballard, architect:—

Henry Hughes.....	£900	J. R. Turner (modified)*....	£800
W. Hopkins	895		

* Accepted.

BISHOPSTOKE (Hants).—For roadmaking, fencing, &c., for the County of Hants Land and Building Society. Mr. William Burrough Hill, surveyor, Southampton:—

Roadmaking.

J. F. Paddington ..	£1,200 0 0	Morgan, Isted, & Morgan	£996 0 0
J. Butt (road and fences).....	1,062 18 5	H. J. Sanders	910 0 0
J. Clark & Son.....	1,0.5 10 10	J. Crook, Swa'hling, Southamp on*	857 7 0

* Accepted.

Fencing.

Morgan, Isted, & Morgan	£224 0 0	Francis Ayles	£119 14 8
J. F. Paddington....	193 0 0	W. Smith	75 12 6
H. Wheeler, Son, & Coombs	140 8 2	H. J. Sanders	75 0 0
		J. Crook, Swathling.	71 7 0

BURSLEM (Staffs.).—Accepted for the erection of a group of school buildings, with caretaker's house, at Longport, for the Burslem School Board. Mr. A. R. Wood, architect and surveyor, Tunstall, Staffs. Quantities supplied:—

Wm. Grant, Burslem..... £4,520 0 0

CADISHEAD (Lancs.).—Accepted for the warming and ventilating of Cadishead day schools:—

John Grundy, London £132 0 0

CHARD.—Accepted for building Institute and Club-house, Chard, for Messrs. Boden & Co. Mr. John Wills, architect, Derby:—

F. Hill, Chard..... £1,415 0 0

CRICKLEWOOD.—Accepted for pulling down old and rebuilding new stables, coach-houses, gardener's cottage, &c., and alterations to back-front of Cricklewood House, for Madame Roper:—

H. B. Oldrey, Kilburn £780 0 0

[No competition.]

DERBY.—Accepted for improvement to Congregational Church, London-road, Derby. Mr. J. Wills, architect, Derby:—

William Eaton, Derby £1,310 0 0

EAKRING (Notts).—For building Wesleyan Chapel, Eakring. Mr. J. Wills, architect, Derby:—

C. Baines, Newark £797 15 0

FAREHAM (Hants).—For the erection of two detached residences at Catisfield, near Fareham, Hants. Mr. Walter Judd, architect, 3, Norfolk-street, Southsea:—

William Blake, Winchester £1,700 0 0

GOWERTON (Glamorganshire).—For alterations and additions to Board School, Gowerton, Longhor, for the School Board. Mr. T. P. Martin, architect, Heathfield-street, Swansea. Quantities by the architect:—

Bennett Bros.	£595	David Jenkins & Co.*	£585
Thomas, Watkins, & Co.....	591		

* Accepted.

[All of Swansea.]

GRAYS THURROCK (Essex)—For granite road metal, for the Grays Thurrock Local Board. Mr. Charles Cobham, surveyor:—

	Quarry.	Per ton. s. d.
W. Grimley & Son	Stoney Stanton.....	13 0
J. Mowlem & Co.	Guernsey	12 3
A. & F. Manuelle	Guernsey	11 11
W. Chandley & Co.	Not stated	11 0
Ch. M. Manuelle	Quenast	11 0
Kent-road Maintenance Co...	Quartzite.....	10 11
J. L. Lyon & Co.	Not stated	10 5
S. T. Cullis & Co.	Ioverness.....	10 4
L. Sommerfeld	Belgium	9 10
W. H. Wheeler	Belgium	9 7
J. Mundy & Co., 23, High-street, Grays*	Belgium	9 6

*Accepted.

HAMPTON-IN-ARDEN (Warwick).—For the erection of four cottages and retail shop, for Miss E. Shorten. Mr. W. J. Ballard, architect:—

Bragg Bros.....	£1,026 0	Thos Wilde*.....	£845 0
Currall & Lewis.....	895 0	Thos. Bates	836 0
T. Millward	856 10	Hundy & Fairbank.....	800
D. Marriott.....	845 0		

* Accepted.

HUCKNALL (Notts.).—Accepted for building Wesleyan schools, Hucknall, near Mansfield. Mr. J. Wills, architect, Derby:—

Henry Gilbert, Kirkby, Notts..... £850 0 0

ITTON COURT (Mon.).—For erecting stables and offices at Itton Court, Monmouthshire. Mr. E. Guy Dawber, architect, 22, Buckingham-street, Adelphi, London, W.C.:—

Stephens, Bastow, & Co. ..	£4,439	Estcourt & Son	£3,994
Foster & Dicksee	4,222	Cowlin & Son	3,959
Drew Bros.	4,200		

JARROW.—For additions to Jarrow police station. Mr. William Crozier, A.M.Inst C.E., County Architect, Shire Hall, Durham. Quantities taken off by Mr. J. Ezra Miller, 1, Tunstall-road, Sunderland:—

Thomas Lumsden	£1,163 0 0
W. C. Atkinson	1,110 11 6
James Storar & Son, Jarrow (accepted)	995 0 0
H. Brown & Co.....	865 19 9

LANGLEY (Bucks).—For the erection of workmen's club and reading room, for the Misses Harvey. Mr. Albert E. Prismore, architect, 2, Broad-street Buildings, E.C. Quantities by Mr. R. J. Stamp :—

J. Deverill	£925 0	H. King & Co.	£770 0
Geo. Easterbrook	832 0	Fassnidge & Son	729 10
John Bowyer	790 0		

LLANDUDNO.—Accepted for building Wesleyan Church parlour and sexton's lodge, Llandudno. Mr. J. Wills, architect, Derby :—
Thos. Jones, Llandudno £747 6 0

LONDON.—For alterations and additions at the "Queen's Head" Hotel, Albemarle-street, Piccadilly, W. Mr. Fred. G. Grierson, architect, 9, Old Jewry Chambers, Cheapside, E.C :—

C. Ansell	£2,280	Edwards & Medway	£1,977
H. & E. Lea	2,095	Courteney & Fairbairn*	1,847
H. Hollingsworth	1,997	* Accepted.	

LONDON.—For alterations and additions at the "Lord Clyde," Copenhagen-street, Caledonian-road, N. Mr. Fred. G. Grierson, architect, 9, Old Jewry Chambers, Cheapside, E.C. :—

H. Hollingsworth	£397 0	F. Voller	£291 0
Edwards & Medway	332 0	Coulsell Bros.	279 0
Courteney & Fairbairn	297 0	H. W. Brown	268 10

LONDON.—For alterations and additions, Hillmartin College, Busby-place, Camden-road, N.W., for Mr. G. F. Carr Vernon. Mr. Arthur S. Pridmore, surveyor, 140, Junction-road, N. :—
Ball & Brown (accepted) £552 4 0

LONDON.—For alterations to the "Paul" beer-house, Paul-street Stratford, for Mr. Frederick Woollard. Mr. W. M. Brutton, architect, 171, Queen Victoria-street, E.C. :—

J. Arnold	£247	Pritchard & Renwick, South wark*	£208
W. J. Maddison	247	* Accepted.	
E. Northwood	£220		

LONDON.—Accepted for new fittings, &c., to "Old Crown and Cushion" public-house, Westminster Bridge-road, S.E., for Messrs. W. J. Grimes & Co. Mr. W. M. Brutton, architect, 171, Queen Victoria-street, E.C. :—
W. Smith, Kennington £1,033 0 0

LONDON.—For alterations, additions, and shop fittings at No. 6, Edwardes-terrace, Kensington, for Mr. Daniel Fazan. Mr. Charles R Guy Hall, architect, 13, St. Alban's-road, Kensington :—

J. Baker & Co.	£757	Leslie & Co., Kensington-square*	£715
Stafford Hill	756	J. H. Hayden	560
J. Whitaker	738	* Accepted subject to modifications.	
C. F. Kearley	723		

LONDON.—For painting and repairs to St. Alban's-place, for Messrs. Aldridge. Mr. E. J. Harrison, architect :—

Smith	£160	E. Houghton & Son	£77
Pitcher	110	Gardner & Hazell	75

LONDON.—For building the "Queen's Arms," Caledonian-road. Messrs Bird & Walters, architects :—

Marks & Co.	£5,226	Todd	£4,020
Gould & Brand	5,193	W. & H. Lascelles	3,957
Tombs	5,170	Burman & Son	3,888
Williams & Son	4,983	Edwards & Medway*	3,833
Goodall	4,160	* Accepted.	

LONDON.—For decorative works, &c., to No. 69A, Hamilton-terrace, Maida Vale, W., for Mr. H. C. Ash. Mr. Walter J. Ebbetts, architect, Savoy House, 115, Strand, W.C. :—

J. Freeman	£1,550	R. A. Yerbury	£1,330
H. Hanks	1,377		

LONDON.—For alterations to the nursery block at the Workhouse, Marloes-road, for the Guardians of the Parish of St. Mary Abbotts, Kensington. Mr. Thos. W. Aldwinckle, architect, 1, Victoria-street, S.W. :—

Head & Son	£236	J. Innwood	£207
James & Darvey	226	H. Haynes	198
Norris & Luke	213	Serff Bros., & Co.	189
Leslie & Co.	211	A. F. Wells*	156
G. F. Kent	209	* Accepted.	

LONDON.—For repairs and alterations to 1 to 8, Addington-street, Lambeth. Mr. A. Parnacott, surveyor, 93, York-road, Lambeth :—

Reed	£288	Lapthorne*	£259
Peacock Bros.	583	* Accepted.	

LONDON.—For alterations and partial reconstruction, Nos. 95 and 97, York-road, for Mr. Roberts. Mr. A. Parnacott, surveyor, 93, York-road, Lambeth :—
Lapthorne ..... £460 | Peacock Bros. (accepted) £426

LONDON.—For alterations and additions to Nos. 26 and 27, Grove End-road, for Mr. S. C. Newton. Mr. Marshall N. Inman, architect :—

Allen & Sons	£1,075	H. B. Oldrey	£895
C. Burge	1,030	Chessum	790
Patman & Fotheringham	897		

LONDON.—Accepted for alterations to Melville House, Mount View-road, N., for Mr. G. Ridout :—
T. B. Lever & Co., Cressida-road, Hornsey £260 0 0

MANSFIELD.—Accepted for extension to Wesleyan Mission Room, Mansfield, Nottingham. Mr. J. Wills, architect, Derby :—
J. Munks, Hucknall Torkard £265 10 0

NEWPORT (Mon.).—For taking down Nos. 22 and 23, Commercial-street, Newport, and erecting new shop, two floors of offices workshops, &c., for the Trustees of the same. Mr. E. A. Lansdowne, architect, Guildhall-chambers, Newport :—

Frank Ashley	£4,545 10 4	Wm. Price	£4,106 0 0
Stephens, Bastow, & Co.	4,368 0 0	E. Richards	3,991 0 0
Dyson Parfitt	4,250 0 0	J. Linton	3 850 0 0
Morgan & Roberts	4,225 0 0	C. Locke	3,775 0 0
A. Linton	4,210 0 0	G. Wilkins	3,748 16 0

PORT TALBOT (Glamorganshire).—Accepted for building Wesleyan Chapel, Port Talbot. Mr. J. Wills, architect, Derby :—
D. C. Jones & Co., Gloucester £1,459 0 0

SETTLE (Yorkshire).—Accepted for building Wesleyan chapel, &c., Settle. Mr. J. Wills, architect, Derby :—
Harger Bros, Settle £1,865 0 0

TUNBRIDGE WELLS.—Accepted for building Baptist Schools, Tunbridge Wells. Mr. J. Wills, architect, Derby :—
J. Jarvis, Tunbridge Wells £1,500 0 0

WOLSINGHAM (co. Durham).—For erecting a new bridge across the River Wear, at Wolsingham. Mr. William Crozier, A.M.Inst.C.E., County Engineer, Shire Hall, Durham. Quantities by Mr. J. Ezra Miller, 1, Tunstall-road, Sunderland :—

Edward Fairless	£4,895 16 2	W. C. Atkinson	
Geo. Westgarth	4,890 0 0	Stockton-on-Tees*	£4,167 16 4
		* Accepted.	

WOODFORD (Essex).—For the erection of detached residence, for Mr. A. J. Hall. Mr. T. Chapman Barralet, architect, Hill-rise, Richmond, Surrey. Quantities supplied :—

Bosley & Son	£791	Cowhead	£744
Osborn & Son	750	White	729

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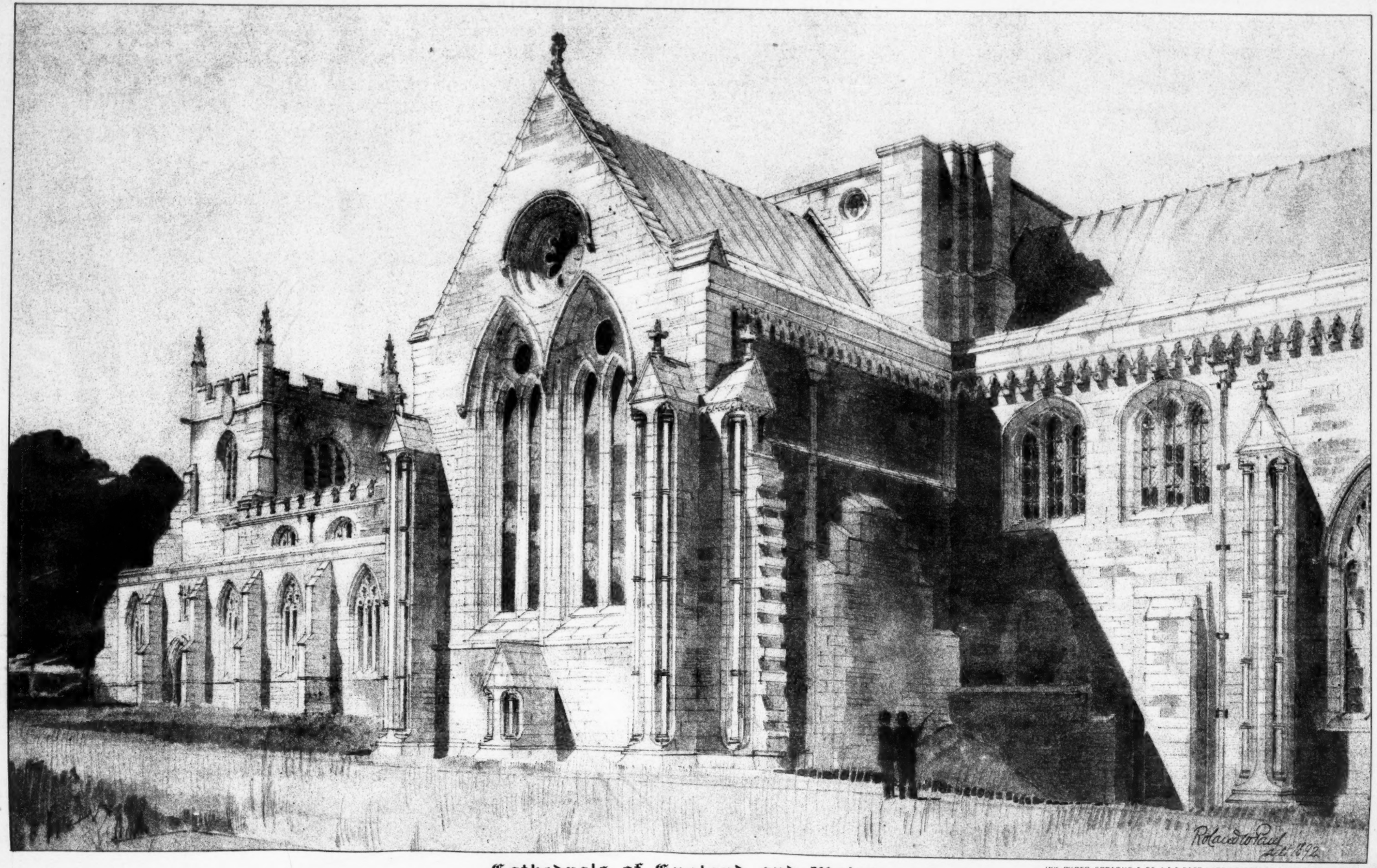

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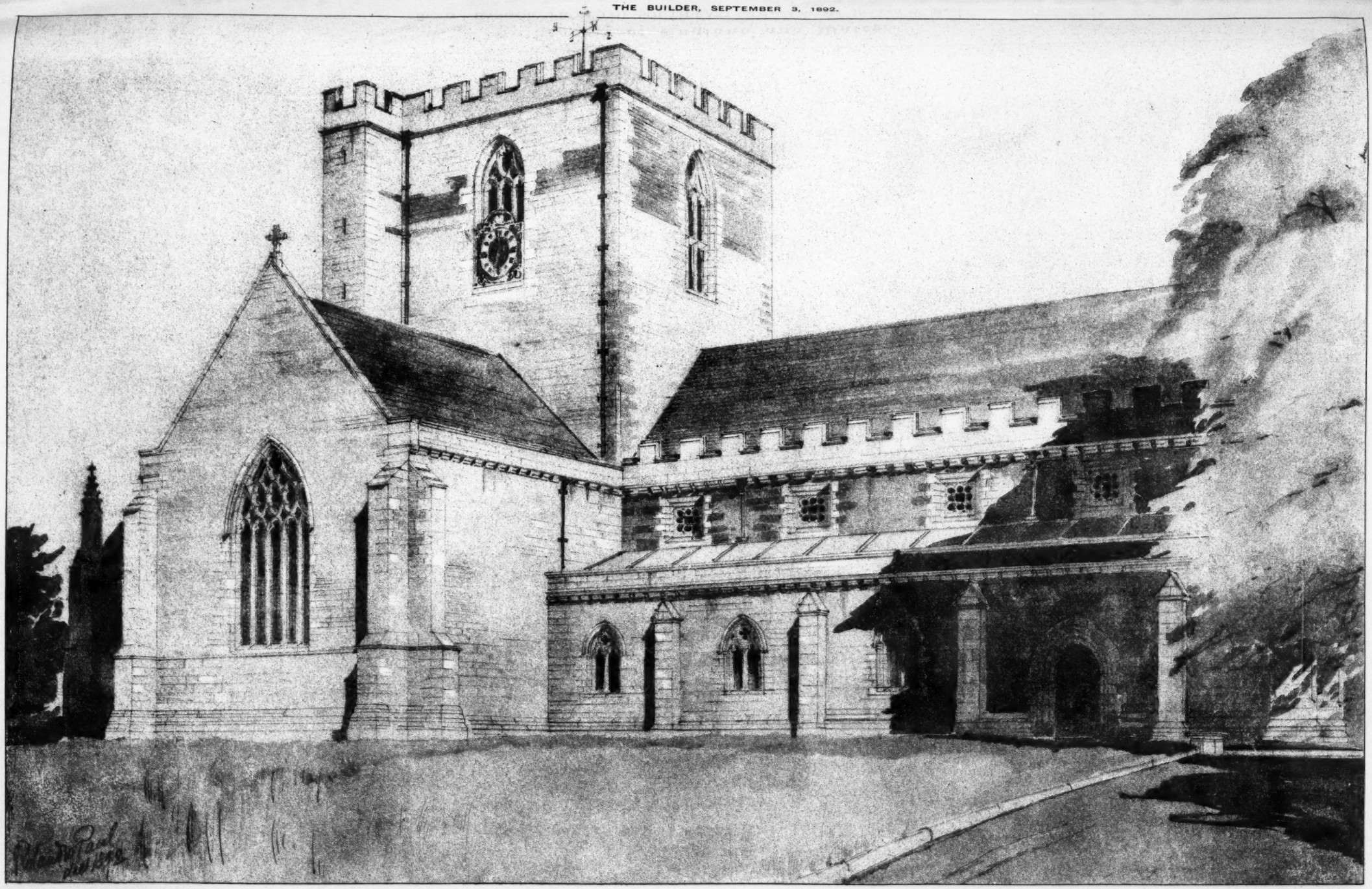

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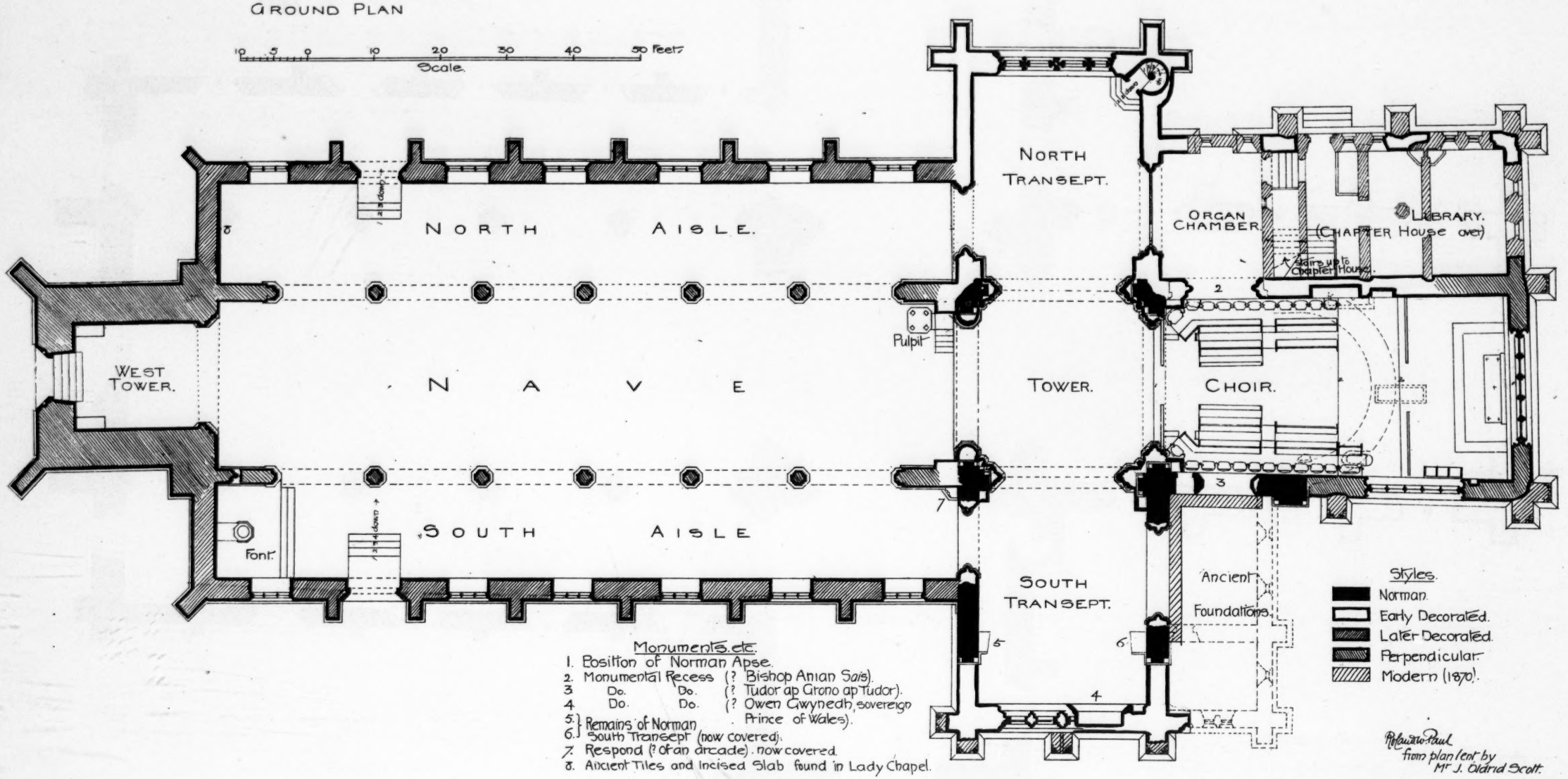
BANGOR CATHEDRAL

GROUND PLAN



Monuments etc.

1. Position of Norman Apse.
2. Monumental Recess (? Bishop Anian Sais).
3. Do. Do. (? Tudor ap Grono ap Tudor).
4. Do. Do. (? Owen Gwyneth, sovereign Prince of Wales).
5. } Remains of Norman South Transept (now covered).
6. }
7. Respond (? of an arcade). now covered.
8. Ancient Tiles and Incised Slab found in Lady Chapel.

R. Kerr & W. Paul
from plan lent by
Mr J. Oldrid Scott.

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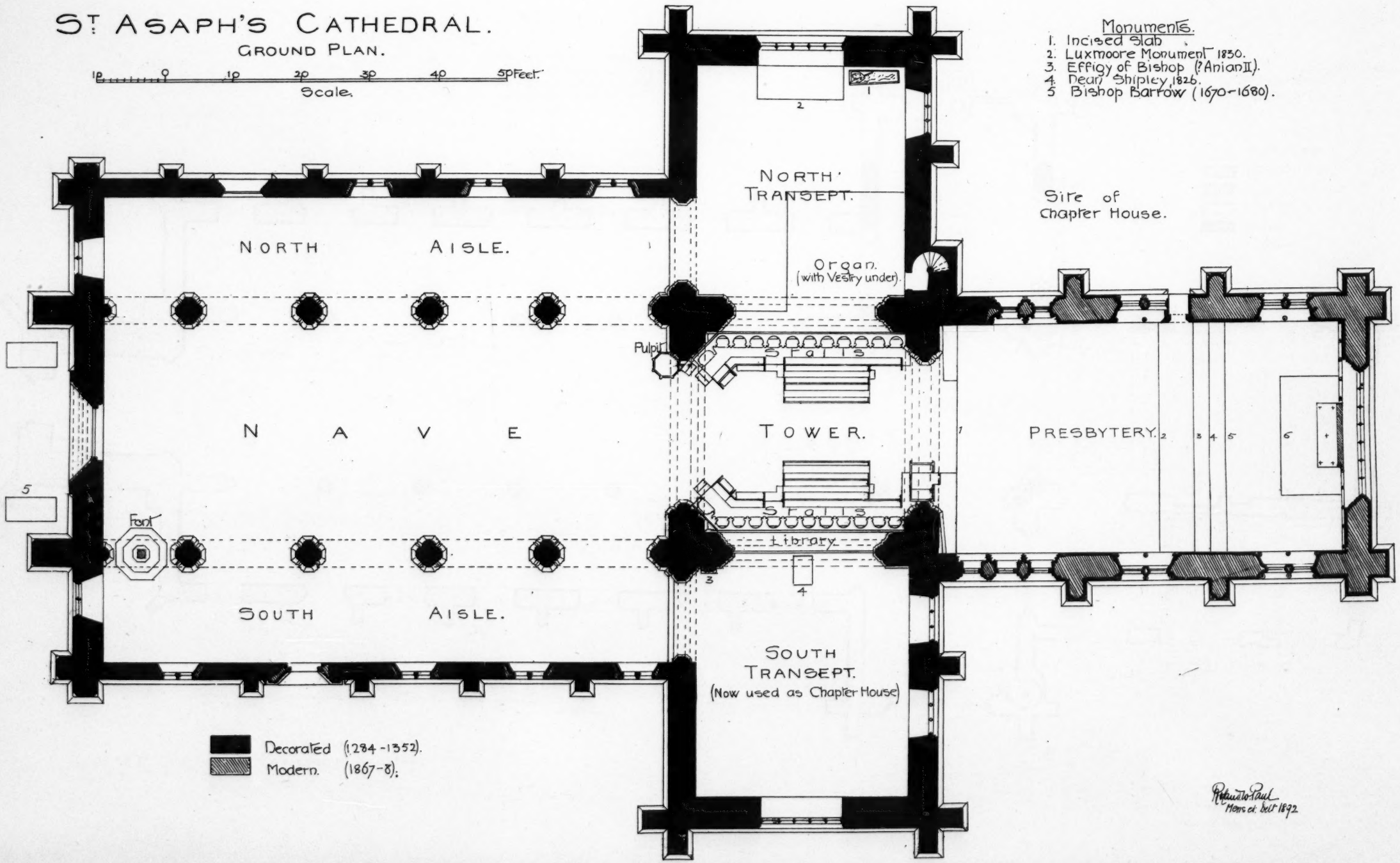
St Asaph's Cathedral.

Ground Plan.

Scale. 10 0 10 20 30 40 50 Feet.



Monuments.
1. Incised Slab
2. Luxmoore Monument 1830.
3. Effigy of Bishop (? Anian II).
4. Dean Shipley 1826.
5. Bishop Barrow (1670-1680).

Richard Paul
Mons et. Delt 1892

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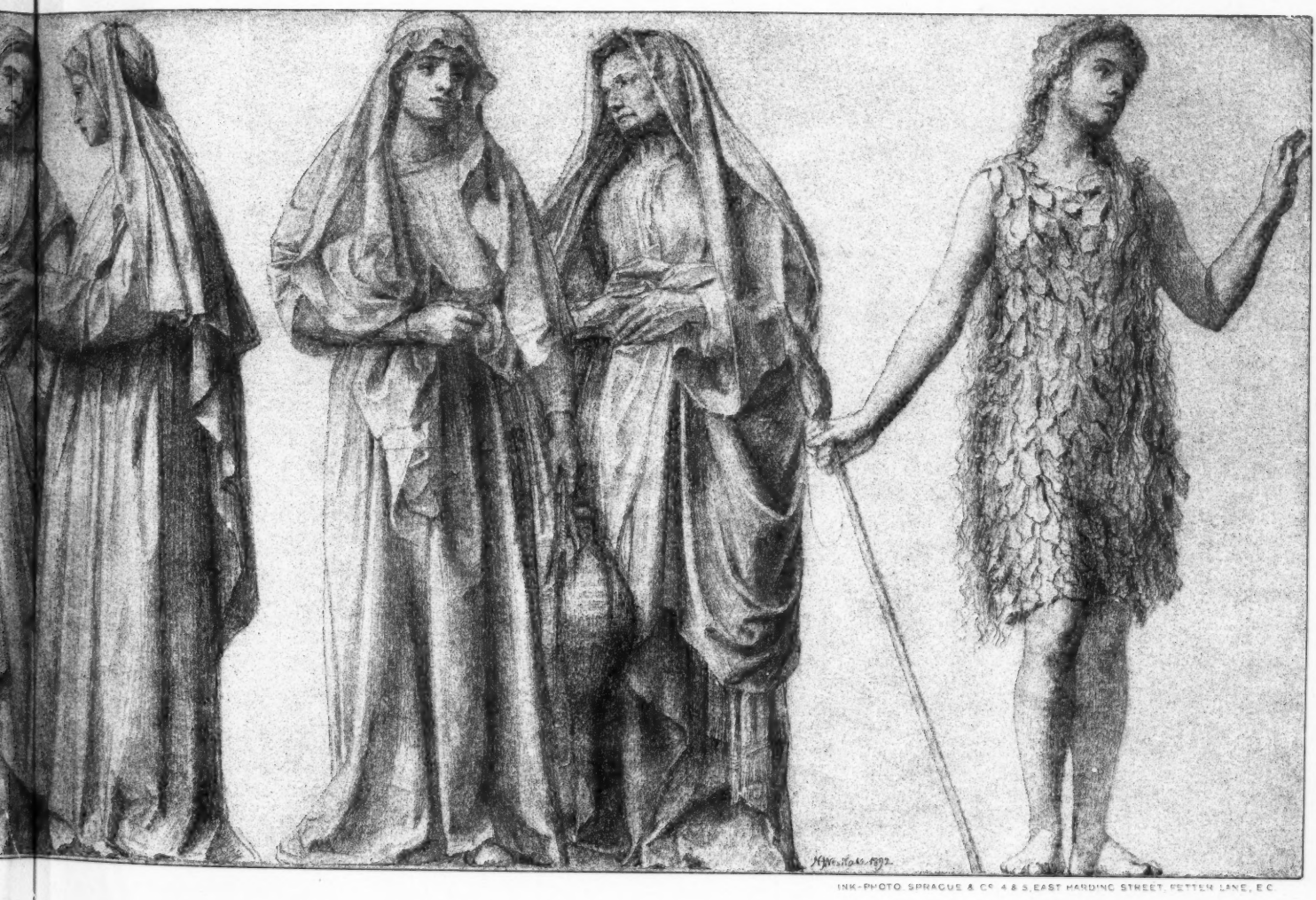
HOLY WOMEN OF THE O
PORTION OF A FRIEZE IN THE CHURCH OF
DESIGNED BY MR. N. H.

Royal Academy Exhibition, 1892.



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OF THE OLD TESTAMENT:
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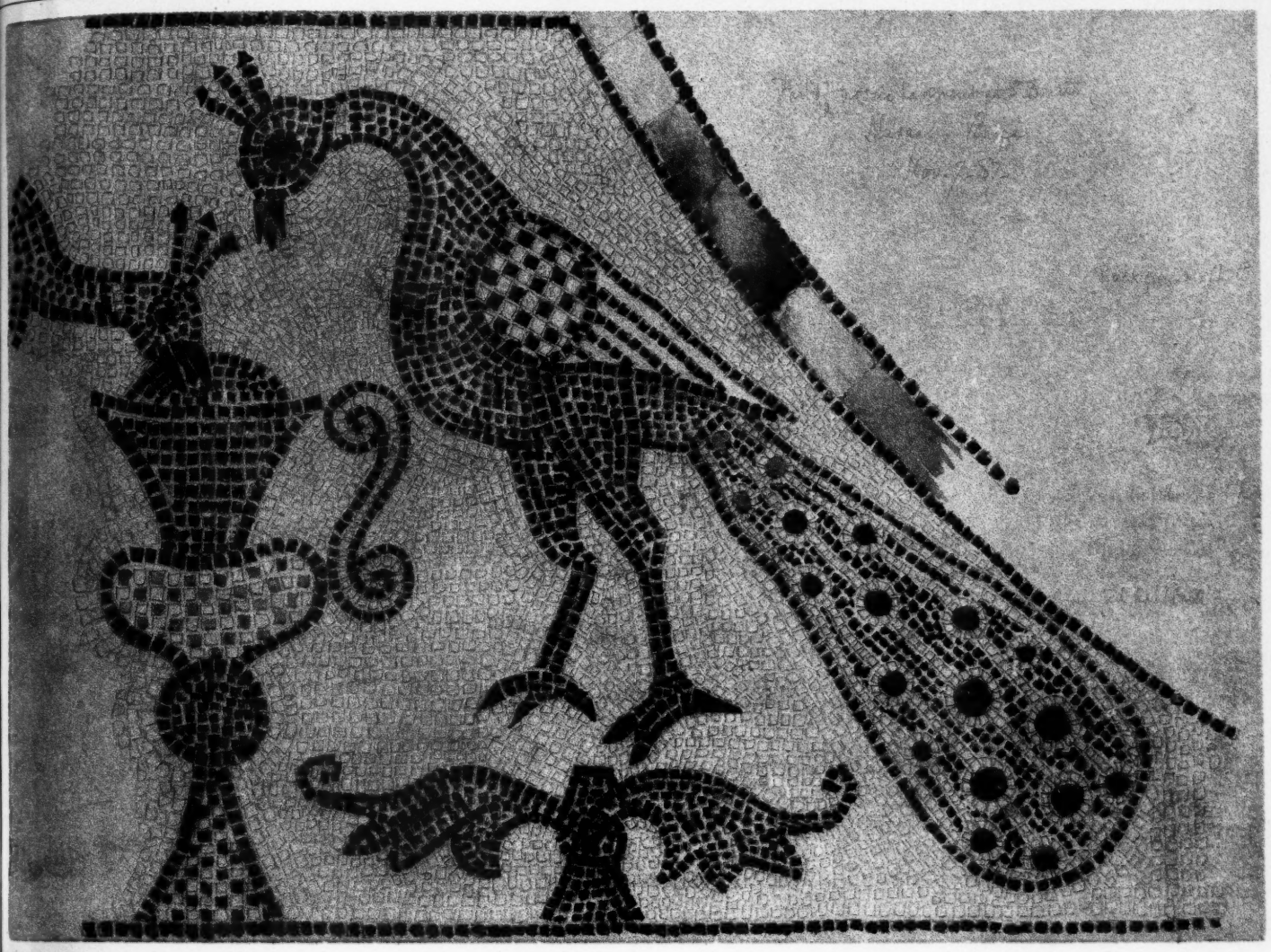
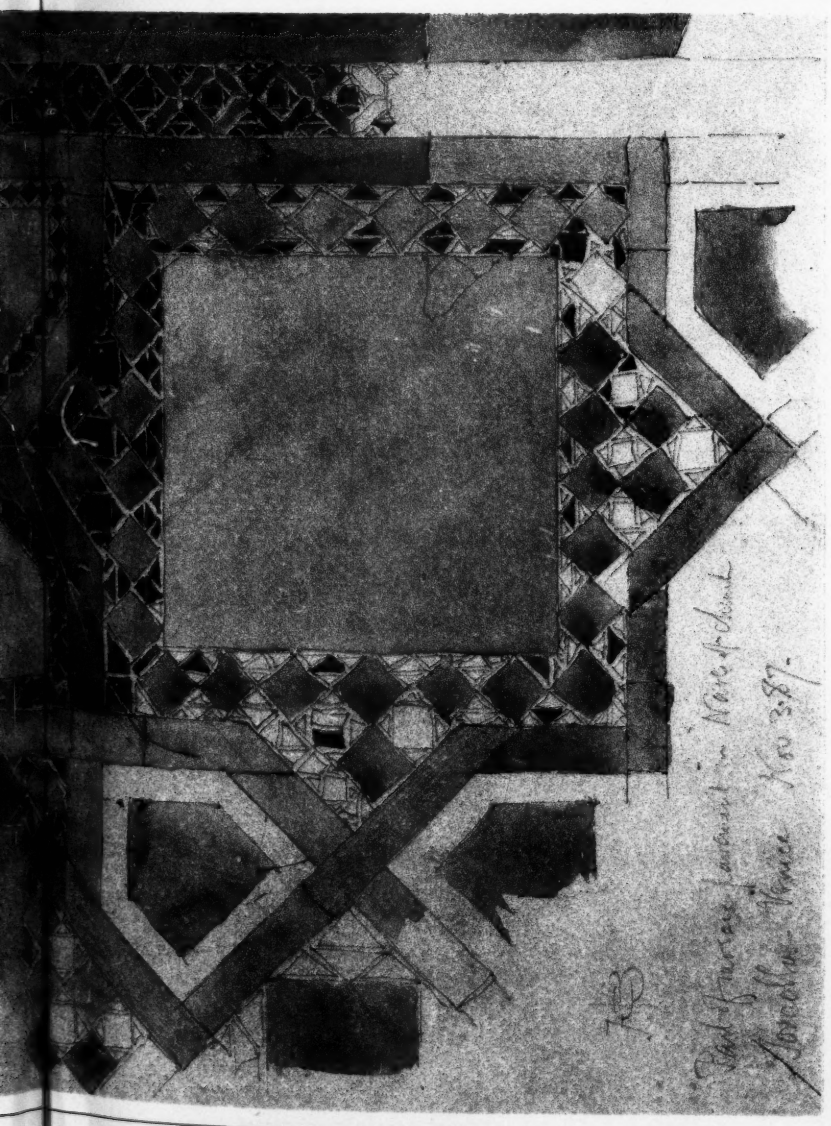
Royal Academy Exhibition, 1892.

MOSAIC PAVEMENTS FROM MURANO, AND INLAY PAVEMEN





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